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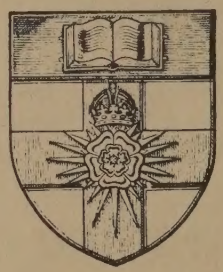
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REPORTS

FROM

COMMISSIONERS, INSPECTORS,

AND OTHERS:

FORTY-SEVEN VOLUMES.

—(5.)—

ARMY (RECRUITING); PATRIOTIC FUND;
SANDHURST COLLEGE;
WOOLWICH ACADEMY; ALKALI, &c., WORKS;
EXPLOSIVES.

SESSION 1.—5 *February* 1895——6 *July* 1895.
SESSION 2.—12 *August* 1895——5 *September* 1895.

VOL. XVIII.

1895.

BIBL. LONDIN. UNIV.

REPORTS

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COMMISSIONERS, INSPECTORS,

AND OTHERS:

1895.

FORTY-SEVEN VOLUMES:—CONTENTS OF THE

FIFTH VOLUME.

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ARMY AND MILITIA.

ANNUAL REPORT

OF THE

INSPECTOR GENERAL OF RECRUITING

FOR

1894.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY HARRISON AND SONS, ST. MARTIN'S LANE,
PRINTERS IN ORDINARY TO HER MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, East Harding Street, Fleet Street, E.C., and
32, Abingdon Street, Westminster, S.W.; or
JOHN MENZIES & Co., 12, Hanover Street, Edinburgh, and
90, West Nile Street, Glasgow; or
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1895.

[C.—7659.] *Price 3d.*

ANNUAL REPORT

OF THE

INSPECTOR GENERAL OF RECRUITING.

Horse Guards, War Office,
8th February 1895.

SIR,

I HAVE the honour to submit, for the information of His Royal Highness, the Commander-in-Chief, the accompanying Report of the recruiting operations for the year 1894, and the work done by this Department.

The Report is divided into six parts:—

I. Regular Army.
II. Army Reserve.
III. Militia.
IV. Militia Reserve.
V. Civil Employment.
VI. General observations.

PART I.

REGULAR ARMY.

Recruits required.

1. The number of recruits required annually to keep the Regular Army up to establishment has varied considerably, owing to alterations in the establishment in the past, but it may now be laid down roughly that the yearly requirements will be from 32,000 to 36,000, so long as the present establishment remains unaltered.

Annual waste.

2. The waste of the Army for the past five years is given in Appendix D., which shows that about 17,000 men are transferred annually to the Army Reserve, and that the waste from other causes is about the same.

Requirements to be met in recruiting.

3. In recruiting for the British Army, more than half of which is stationed abroad, and which is raised by voluntary enlistment, the following difficulties have to be contended with:—

(*a.*) We have to obtain a sufficient number of recruits to meet the total annual waste.

(*b.*) We have to find men of the proper age, height, physique, and trade, to meet the requirements of the various Arms of the Service.

(*c.*) We have to distribute them, as they are obtained, amongst the several regiments and corps, to meet not only present, but future, requirements; and this is no small difficulty, bearing in mind that the establishment of battalions varies with their location at home and abroad, and that recruits before enlistment almost invariably select the corps they wish to join.

(*d.*) We have to keep our Army in India up to full strength with trained soldiers of not less than 20 years of age.

British establishment.

4. The British establishment of the Army at Home and in the Colonies, as voted by Parliament, can never at any time of the year be exceeded, and this requires careful watching, particularly between the months of April and September, since during that period there is no drain upon it for Indian drafts. The first troopship leaves England with drafts for India early in September, and the men embarking are, on the day the ship leaves, struck off the British establishment. We endeavour, therefore, to recruit up to full numbers by the 1st of September. If the British establishment were complete two or three months before this date, restrictions would have to be

A p. 4064. 85450. Wt. 24789.

placed on recruiting to prevent the number enlisted exceeding the ordinary monthly waste Restrictions are very detrimental to recruiting, as it is found by experience that it is sometimes months before the usual flow of recruits comes in after the restrictions are taken off. From this it will be seen that the state of the Army on the 1st of September is the best test of the effect of recruiting for the year.

British and Indian establishments.

5. The following table shows the British and Indian rank and file establishments, and the numbers wanting or supernumerary, on the 1st of each month during the past five financial years.

Table I.

Years.	Numbers provided in Army Estimates.	Numbers wanting or supernumerary on the 1st of each month.										
		April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1890–1891.													
British Establishment	125,246	− 7,652	− 6,741	− 6,582	− 6,323	− 5,499	− 4,447	− 6,557	− 5,673	− 5,415	− 5,964	− 5,336	− 6,820
Indian Establishment	64,951	+ 1,060	− 593	− 1,017	− 1,179	− 1,336	− 1,466	+ 1,444	+ 1,837	+ 1 129	+ 1,314	+ 1,482	+ 2,337
Total - -	190,197	− 6,592	− 7,334	− 7,599	− 7,502	− 6,835	− 5,913	− 5,113	− 3,836	− 4,286	− 4,650	− 3,854	− 4,483
1891–1892.													
British Establishment	125,502	− 6,940	− 6,789	− 6,512	− 5,995	− 5,425	− 4,168	− 5,965	− 4,497	− 4,310	− 4,583	− 3,754	− 4,758
Indian Establishment	65,036	+ 1,631	− 194	− 1,800	− 2,085	− 2,291	− 2,483	+ 348	+ 507	+ 753	+ 492	+ 274	+ 157
Total - -	190,538	− 5,309	− 6,983	− 8,312	− 8,080	− 7.716	− 6,651	− 5,617	− 3,990	− 3,557	− 4,091	− 3,480	− 4,601
1892–1893.													
British Establishment	125,669	− 5,227	− 5,160	− 4,485	− 3,632	− 2,271	− 583	− 1,903	− 1,916	− 158	− 1,791	+ 201	− 1,206
Indian Establishment	65,180	+ 1,501	+ 550	− 238	− 438	− 624	− 815	+ 1,708	+ 3,574	+ 2,455	+ 3'398	+ 2,018	+ 2,392
Total - -	190,849	− 3,726	− 4,610	− 4,723	− 4,070	− 2,895	− 1,398	− 105	+ 1,658	+ 2,297	+ 1,607	+ 2,219	+ 1,186
1893–1894.													
British Establishment	126,057	− 2,458	− 2,536	− 2,630	− 2,257	− 1,333	− 321	− 2,710	− 1,066	+ 754*	− 1,912	− 1,273	− 2,212
Indian Establishment	65,463	+ 2,361	+ 1,284	+ 751	+ 609	+ 432	+ 313	+ 4,057	+ 3,969	+ 2,261	+ 4,288	+ 3,798	+ 3,733
Total - -	191,520	− 97	− 1,252	− 1,879	− 1,648	− 901	− 8	+ 1,347	+ 2,903	+ 3,015	+ 2,376	+ 2,525	+ 1,521
1894–1895.													
British Establishment	126,921	− 4,614	− 3,861	− 2,971	− 2,375	− 1,348	+ 205	− 2,201	− 1,633	− 854	− 861		
Indian Establishment	65,730	+ 4,446	+ 2,647	+ 1,593	+ 1,365	+ 1,212	+ 1,025	+ 4,357	+ 5,185	+ 4,250	+ 4,395		
Total - -	192,651	− 168	− 1,214	− 1,378	− 1,010	− 136	+ 1,230	+ 2,066	+ 3,552	+ 3,396	+ 3,534		

* 1,278 men (cavalry and infantry only) on 1st of December at Netley and the discharge depôt from India awaiting disposal, included on British establishment.

From the above table it will be seen that the British establishment was, on the 1st of September last, exceeded by 205. It was, however, on the following day, when the Indian drafts were struck off, 864 under establishment. The Army in India is at its lowest ebb in September, and is then gradually increased in strength by drafts from home till the following April, when the draft supply ceases. It then begins to decrease in numbers till the trooping season re-commences in the following September. During this period (from April to September) the Army on British establishment is, on the contrary, gradually gaining in strength, so as to be able to meet the drain upon it when the Indian drafts begin to embark.

6. During the year 1894, 33,698 recruits joined the regular Army, and these numbers, as explained in the preceding paragraphs, must be considered satisfactory, since the Army on the 1st of September was rather over establishment. Of these—

Numbers enlisted.

1,708 were enlisted for long service (12 years with the colours).
30,622 were enlisted for short service (7 years with the colours and 5 years with the reserve).
1,368 were enlisted for short service (3 years with the colours and 9 years with the reserve).

Total 33,698

7. The distribution of these recruits amongst the various arms of the service will be seen in the following table, in which is included, for comparison, the recruits raised for each arm during the preceding four years. Distribution of recruits.

Table II.

	Recruits joined each Arm.				
	1890.	1891.	1892.	1893.	1894.
Household Cavalry	144	167	167	128	135
Cavalry of the Line	2,893	3,606	4,022	3,086	3,108
Royal Artillery	5,469	4,961	5,940	5,645	5,003
Royal Engineers	984	811	920	661	811
Foot Guards	1,221	1,604	1,832	1,101	1,026
Infantry of the Line	19,296	22,980	25,699	23,266	22,375
Colonial Corps	501	705	2,063	436	353
Army Service Corps	457	541	460	429	415
Ordnance Store Corps	21	67	113	69	82
Medical Staff Corps	358	373	414	360	341
Army Post Office Corps	17	4	5	2	40
Corps of Ordnance Artificers	11	15	8	—	—
Corps of Armourers	35	34	14	12	9
Corps of Army Signallers	—	135	2	—	—
Total	31,407	36,003	41,659	35,195	33,698

The Corps of Ordnance Artificers is now merged in the Royal Artillery. The Corps of Army Signallers has been abolished.

8. The standard of height and chest measurement, and the minimum age and weight for recruits in the various arms of the service, are as under :— Standard of height and chest measurements.

(a.) *Height.*

Cavalry of the Line	5 ft. 6 ins. to 5 ft. 11 ins.
Artillery (garrison gunners)	5 ft. 7 ins. and upwards.
„ (field gunners)	5 ft. 6½ ins. and upwards.
Royal Engineers (sappers)	5 ft. 6 ins. and upwards.
Foot Guards	5 ft. 9 ins. and upwards.
Infantry of the Line	5 ft. 4 ins. and upwards.
Army Service Corps, Medical Staff Corps, Ordnance Store Corps	5 ft. 3 ins. to 5 ft. 5 ins.
Royal Artillery and Royal Engineers (drivers)	5 ft. 4 ins. to 5 ft. 6 ins.
Army Service Corps (drivers)	5 ft. 3 ins. to 5 ft. 5 ins.

(b.) *Minimum Chest Measurement* (*except for Drivers and Artificers of the Royal Artillery and Royal Engineers*).

33 inches for men of 5 ft. 3 ins. and under 5 ft. 6 ins.
34 „ „ 5 ft. 6 ins. „ 5 ft. 10 ins.
35 „ „ 5 ft. 10. ins. and upwards.

(c.) *Minimum Age*, 18 *years.* (d.) *Minimum Weight*, 115 *lbs.*

9. It has been found by experience that it is not easy to raise in any one year more than from 23,000 to 27,000 recruits for the regular Army who are up to the highest standard, and, as from 32,000 to 36,000 are annually required, it is evident to obtain the numbers wanted either the standard must be lowered or some margin be allowed. The higher the standard can be maintained the better is the general average of the recruits; it is therefore fixed as high as possible, but recruiting officers are allowed to take growing lads for the Infantry of the Line from ¼ to ½ in. under height, and one inch under chest measurement, according as they are under or over 20 years of age, and under or over 5 ft. 6 ins. in height.* Returns of all these recruits are sent in weekly to the Inspector General of Recruiting, and are carefully checked. Recruits slightly below these measurements may be recommended by recruiting officers, but they cannot be approved until the authority of the Inspector General of Recruiting has been received. The physique of recruits as they come in Recruits under standard.

* Owing to the briskness of recruiting since the commencement of the year, this permission has been lately limited to ¼ inch under height, and ½ inch under chest measurement.

can thus be regulated, to some extent, at Head-quarters, in accordance with the numbers required, and it is thought that by this means a better stamp of recruit is obtained than would be the case if the regulation standard were lowered.

Recruits enlisted under standard.

10. The following table shows the total number of recruits raised, the numbers taken under any of the standards, and the percentage of such enlistments, for the past five years :—

Table III.

	1890.	1891.	1892.	1893.	1894.
Total number of recruits joined during the year (exclusive of Colonial Corps).	30,906	35,298	39,596	34,759	33,345
Total number under any of the standards.	7,975	11,622	12,101	7,759	8,463
Percentage under standard -	25·8	32·9	30·6	22·3	25·4

The increase in the percentage of men under standard during the current year was expected, and may be considered as the direct consequence of the restrictions imposed on the Militia recruiting from November 1893 to March 1894, as many of the growing lads, who were thus prevented from entering the Militia and drilling on enlistment, would have joined that force, and in all probability have developed to standard before entering the Army.

Recruits enlisted under standard.

11. Table IV. below shows the distribution of the recruits specially enlisted during the first six months of 1894 who were still serving in the Cavalry, Royal Artillery, Foot Guards, and Infantry, at the commencement of the present year, and the number still under standard at that date.

Table IV.

Arm.	Number still serving who were enlisted under standard during the first six months of 1894.	Number who were still under standard on 2nd Jan. 1895.	Number who had reached the standard measurements on the 2nd Jan. 1895.	Number absent or otherwise not available for re-measurement.
Cavalry - - - -	221	52	117	52
Royal Artillery - - - -	151	50	71	30
Foot Guards - - - -	105	34	68	3
Infantry - - - - -	2,054	586	968	500
Total - - -	2,531	722	1,224	585
		2,531		

Social position of recruits.

12. The social position of recruits is steadily improving, since more men of the middle classes are now joining the Army with the view of rising to the higher Non-commissioned ranks, or to Warrant Officers, and retiring on a good pension. The spread of education, too, is naturally having an effect, and the cases are now rare in which a recruit can neither read nor write. The number of men who have learned trades is diminishing, but the number who have been employed as clerks is increasing. This is no doubt owing to the wages of the former having of late years increased, whilst the wages of clerks are now extremely low.

Cavalry.

13. There has been no difficulty in keeping the Household Cavalry and Cavalry of the Line up to establishment, with a good stamp of recruit, as service in this arm is very popular.

Artillery.

14. The higher standards for the Royal Artillery, which were adopted last year, have been maintained. The standard was raised on the 1st of March 1893, in the case of Gunners from 5 feet 6 inches to 5 feet 7 inches (Field Gunners 5 feet 6½ inches), and in the case of Drivers from 5 feet 3 inches to 5 feet 4 inches.

Engineers.

15. The Royal Engineers have been kept well supplied with recruits during the year.

Foot Guards.

16. The standard of height for the Foot Guards, which was raised in November 1893 from 5 feet 8 inches to 5 feet 9 inches, has been maintained, and the three regiments have been kept well supplied with men of excellent physique. The average height on the 1st of January 1895 was—Grenadier Guards, 5 feet 9⅞ inches; Coldstream Guards,

5 feet 9 $\frac{15}{16}$ inches; Scots Guards, 5 feet 10$\frac{3}{8}$ inches. The following table shows the number of recruits enlisted into the Foot Guards for 12, 7, or 3 years respectively with the colours during the past four years :—

Table V.

Term of Colour Service.	1891.	1892.	1893.	1894.
12 years	37	42	45	25
7 years	633	585	297	326
3 years	934	1,205	759	675
Total	1,604	1,832	1,101	1,026

Infantry.

17. The numbers provided in the Army Estimates for the present year for the Infantry of the Line (Rank and File) on the 1st of September, prior to the departure of the first troopship, were deficient only by 383 Rank and File. The Infantry of the Line has not been so near the numbers voted since 1888. The following table shows the British and Indian establishments (Rank and File), and the numbers wanting or supernumerary, on the 1st of September for the past five years :—

Table VI.

Establishments.		1890.	1891.	1892.	1893.	1894.
British	Establishment	73,086	73,243	73,289	73,296	74,067
	Effectives	71,765	71,142	71,553	72,094	73,684
	Wanting	1,321	2,101	1,736	1,202	383
	Supernumerary	—	—	—	—	—
Indian	Establishment	48,760	48,813	48,813	48,932	48,932
	Effectives	47,386	46,483	48,124	49,542	49,582
	Wanting	1,374	2,330	689	—	—
	Supernumerary	—	—	—	610	650
British and Indian	Establishment	121,846	122,056	122,102	122,228	122,999
	Effectives	119,151	117,625	119,677	121,636	123,266
	Total wanting	2,695	4,431	2,425	592	—
	Total supernumerary	—	—	—	—	267

Colonial Corps.

18. The results of recruiting for the various Colonial Corps are shown in the following table :—

Table VII.

Corps.	Rank and File (on 1st Jan. 1895).		
	Establishment.	Effectives.	Wanting or Supernumerary.
West India Regiment	1,976	1,924	— 52
Royal Malta Artillery	338	339	+ 1
Royal Artillery — Sierra Leone Company	92	92	—
Royal Artillery — West India Companies	186	191	+ 5
Royal Artillery — Asiatic Companies	898	820	— 78
Royal Engineers — Eastern Battalion	158	155	— 3
Royal Engineers — West India Companies	129	127	— 2
Hong Kong Regiment	918	888	— 30
Total Rank and File	4,695	4,536	—159

Army Service Corps.

19. The establishment of the Army Service Corps is 3,141 Non-Commissioned Officers and Men, and as this Corps is very popular, and the standard of height only 5 ft. 3 ins. to 5 ft. 5 ins., there has been no difficulty in keeping it up to strength. Its establishment is complete.

Ordnance Store Corps.

20. The Ordnance Store Corps has a small establishment of 847, and is composed principally of artisans. It is slightly under establishment.

Medical Staff Corps.

21. The establishment of the Medical Staff Corps is 2,478 Non-Commissioned Officers and Men. This is a popular Corps, and easily recruited. It is somewhat over establishment.

Corps of Armourers.

22. The establishment of the Corps of Armourers is 307, and is practically complete.

Enlistment of men belonging to the Militia.

23. The number of Militiamen who have joined the Regular Army, Royal Navy, or Royal Marines, during the past five years, is given below, distinguishing those who joined the Line Battalions of their Territorial Regiments, or the Royal Artillery or Royal Engineers from the Artillery or Engineer Militia.

Table VIII.

Corps which the Men joined.	1890.	1891.	1892.	1893.	1894.
Territorial Regiment or Royal Artillery or Royal Engineers.	6,215	6,640	7,868	7,420	6,744
Other Corps of the Regular Army	6,431	6,902	7,791	6,894	6,520
Royal Navy or Royal Marines	445	395	407	485	523
Not reported	16	—	—	—	—
Total	13,107	13,937	16,066	14,799	13,787

Enlistment of enrolled Volunteers.

24. No inducement or pressure of any kind is brought to bear on enrolled Volunteers to join the Regular Forces, yet a certain number come forward annually for enlistment, a very small proportion, however, since the average numbers are only about 1 per cent. of the entire force. The following are the numbers who have joined during the past five years :—

In 1890	-	1,895	joined from the Volunteers.
In 1891	-	2,180	,, ,,
In 1892	-	2,336	,, ,,
In 1893	-	2,257	,, ,,
In 1894	-	*	,, ,,

Recruiting agencies.

25. The various agencies through which the recruits were raised are given in Appendices A. and B.

Increase and decrease of each arm.

26. The increase and decrease of each arm of the service during the year is shown in Appendix C.

State of the Army for the past five years.

27. The state of the Army on the 1st of January for the past five years, and the increase and decrease during these years, is given in Appendix D.

Recruiting and population in the United Kingdom.

28. The following table shows the population and results of recruiting in England, Wales, Scotland, and Ireland, for the past five years. The population is that taken at the census of 1891 :—

Table IX.

	Population.	Number of Recruits finally approved.				
		1890.	1891.	1892.	1893.	1894.
England and Wales	29,002,525	24,846	28,863	32,094	28,444	26,763
Scotland	4,025,647	2,485	3,036	3,567	3,046	3,232
Ireland	4,704,750	3,587	3,447	3,860	3,357	3,446
Total	37,732,922	30,918	35,346	39,521	34,847	33,441

* The returns for 1894 are not yet completed.

The drain on the population by recruiting cannot be said to be excessive, since not 1 man per 1,000 is enlisted annually, and only about 5 men per 1,000 of the total population are, at the present time, serving as soldiers in the Regular Army.

29. The medical inspections have been generally very strictly carried out. The number of recruits who have been passed into the service with diseases or ailments that might have been detected at the medical examination is exceedingly small when compared with the numbers examined, which shows that the medical officers have performed this important, and, in some places where large numbers of recruits are examined, arduous duty, with care and ability. Medical examination.

30. Table X. below gives the number of recruits who offered for medical examination, the numbers rejected for various ailments, and the percentage of rejections during the past five years. Medical rejections.

Table X.

Cause of Rejection.	Number rejected.				
	1890.	1891.	1892.	1893.	1894.
Various ailments	11,536	12,680	13,760	13,152	13,020
Under chest measurement	5,623	5,715	6,600	6,962	6,839
Under height	1,392	1,642	2,250	2,133	1,777
Under weight	2,441	1,991	1,902	2,564	2,455
Age apparently not as prescribed by regulation	510	592	761	664	449
Not likely to become efficient soldiers	430	533	997	799	438
Total rejected for want of physical development.	10,396	10,473	12,510	13,122	11,958
General total rejected	21,932	23,153	26,270	26,274	24,978
Number who offered for medical examination.	55,367	61,322	68,761	64,110	61,985
Percentage of rejections	39·6	37·8	38·2	41·0	40·3

31. The annexed table shows the number of men, under one year's service and between one and two years' service, respectively, who were discharged as invalids annually during the last five years, and the proportion of such invalids to the effective strength. Discharge by invaliding.

Table XI.

Year.	Number of men under two years' service on 1st January in each year.			Invalids discharged during the year under two years' service.			Proportion of Invalids per 1,000 Effective under two years' service.		
	Under one year.	From one to two years.	Total.	Under one year.	From one to two years.	Total.	Under one year.	From one to two years.	Total.
1890	26,638	21,078	47,716	304	355	659	11	17	14
1891	27,973	23,898	51,871	364	375	739	13	16	14
1892	31,296	24,908	56,204	398	400	798	13	16	14
1893	36,495	28,026	64,521	473	489	962	13	17	15
1894	31,522	32,570	64,092	433	337	770	14	10	12

32. The number of men who deserted and rejoined from desertion during the past five years is given in the following table:— Desertion.

Table XII.

Years.	Total Desertions.	Number Rejoined from Desertion.	Net Waste by Desertion.
1890	4,134	1,565	2,569
1891	4,631	1,707	2,924
1892	4,962	1,944	3,018
1893	4,827	2,101	2,726
1894	3,958	1,833	2,125

Discharges by purchase.

33. The number of men who purchased their discharge, within the first three months of their service and after that period, for the past five years, is given below :—

Table XIII.

Years.	Under Three Months' Service on Payment of 10*l.*	Three Months' Service and upwards on Payment of 18*l.*	Total.
1890	1,313	1,584	2,897
1891	1,561	1,527	3,088
1892	1,666	1,467	3,133
1893	1,302	1,315	2,617
1894	1,218	1,236	2,454

PART II.

Army Reserve.

Growth of the Army Reserve.

34. On the 1st of January 1875 the strength of the 1st Class Army Reserve was 7,845, and during the 20 years that have since elapsed it has increased, year by year, till on the 1st of January 1895 it reached a total of 82,804 men.

Numbers annually transferred.

35. The following table shows the number of men transferred to the 1st Class Army Reserve on completion of colour service during the past five years, and those permitted to pass to the reserve before completing their colour service. From this it will be seen that the numbers transferred annually during the past four years have been between 16,000 and 18,000, and these will probably be about the numbers in the future.

Table XIV.

Year.	On completion of Colour Service.	Before completing Colour Service.	Relegated to the Reserve having re-enlisted irregularly.	Total.
1890	12,085	2,042	72	14,199
1891	16,128	1,676	90	17,894
1892	16,320	1,430	140	17,890
1893	15,624	1,466	168	17,258
1894	14,796	1,330	103	16,229

Strength of the 1st Class Army Reserve.

36. The following table shows the state of the 1st Class Army Reserve on the 1st of January during the past five years, the numbers belonging to the various Arms of the Service, and those belonging to the three sections of the Reserve.

Table XV.

Year.	Arms of the Service.											Total Strength.
	Cavalry.	Royal Artillery.	Royal Engineers.	Foot Guards.	Infantry of the Line.	Army Service Corps.	Medical Staff Corps.	Ordnance Store Corps.	Army Post Office Corps.	Corps of Army Signallers.	Colonial Corps.	
1891	4,211	5,759	1,383	3,746	40,679	2,056	1,039	176	111	—	120	59,280
1892	4,577	7,066	1,556	4,216	47,075	2,219	1,068	200	112	*109	123	68,421
1893	5,544	8,057	1,887	4,566	52,564	2,396	1,120	222	111	—	128	76,595
1894	6,889	9,088	2,152	4,813	53,244	2,491	1,175	240	110	—	147	80,349
1895	7,290	9,529	2,254	5,028	54,515	2,519	1,163	249	110	—	147	82,804

Year.	Numbers provided for in Army Estimates.	Sections of the 1st Class Army Reserve.			
		Section B.	Section C.	Section D.	Total Strength.
1891	62,500	47,965	4,221	7,094	59,280
1892	71,800	55,474	3,814	9,133	68,421
1893	78,000	62,924	3,267	10,404	76,595
1894	80,000	69,044	2,463	8,842	80,349
1895	84,300	74,293	2,059	6,452	82,804

* Corps abolished in 1893.

Section B. consists of men who are transferred from the Colours to complete their 12 years' engagement on the termination of their period of Army Service (usually 7 or 8 years).

Section C. consists of men who are prematurely passed to the Reserve, as an indulgence, before completing their Colour Service, but they are passed into Section B. as soon as the time they had engaged to spend with the Colours expires.

Section D. consists of men who, after completing their 12 years' engagement, are allowed to re-enlist for a further term of 4 years in the 1st Class Army Reserve. Enlistments into Section D. were suspended early in 1893; therefore these Reservists are gradually dying out.

Normal strength of the Reserve.

37. The Short Service System has been in full operation since 1878, and it is therefore clear that the normal Reserve (Section B.) has now reached its fullest expansion, in fact this section is at present somewhat above its normal maximum strength, in consequence of the exceptionally large number of men who were passed into it, on completing their Colour Service in 1891, 1892, and 1893, as the necessary result of the large number of recruits taken in 1884, 1885, and 1886, in order to meet increased establishments. From this it would appear that the present strength of the 1st Class Army Reserve can hardly be maintained by transfers from the Colours to Section B. in the ordinary course, and that, if the present numbers are intended to be kept up, it will probably become necessary either to encourage men to pass to Section C. in greater numbers than at present, or to re-open Section D.

Increase and decrease of the Army Reserve.

38. The following is a statement of the causes of increase and decrease of the 1st Class Army Reserve during the past five years :—

Table XVI.

	1890.	1891.	1892.	1893.	1894.
Effectives on 1st of January in each year	54,136	59,280	68,421	76,595	80,349
Increase—					
Transfers from the Colours	14,136	17,820	17,635	17,121	16,053
Enrolled in Section "D"	2,384	2,731	3,048	605	—
Rejoined from absence	248	232	295	292	258
Other causes	14	11	17	24	29
Total increase	16,782	20,794	20,995	18,042	16,340
Decrease—					
Dead	441	511	501	551	616
Discharged. After 21 years' service	6	4	—	—	—
Discharged. On completion of engagement.	9,785	9,689	10,557	12,096	11,931
Discharged. As Invalids	23	36	44	48	50
Discharged. By purchase	15	8	11	17	18
Discharged. Free by Indulgence	2	5	4	6	5
Discharged. For misconduct	75	66	116	157	168
Discharged. Miscellaneous	4	5	9	23	21
	9,910	9,813	10,741	12,347	12,193
Transfers to the Colours	24	37	71	56	62
Struck off for absence	1,254	1,258	1,357	1,331	1,014
Other causes	9	34	151	3	—
Total decrease	11,638	11,653	12,821	14,288	13,885
Net increase	5,144	9,141	8,174	3,754	2,455
Net decrease	—	—	—	—	—
Effectives on the 31st December in each year.	59,280	68,421	76,595	80,349	82,804

Absentees from the Reserve.

39. It is satisfactory to note that the proportion of absentees struck off from the 1st Class Army Reserve, as compared with its strength, is year by year diminishing, as the following table will show :—

Table XVII.

Years.	Struck off as Absentees during each year.	Effective Strength of the 1st Class Army Reserve on the 1st of January in each Year.	Proportion of Absentees to 1,000 of the Effective Strength.
1890 - -	1,254	54,136	23
1891 - -	1,258	59,280	21
1892 - -	1,357	68,421	19
1893 - -	1,331	76,595	17
1894 - -	1,014	80,349	13

PART III.

Militia.

Recruits raised.

40. During the past year 33,205 recruits were raised for the Militia. This shows a falling off of 12,566 as compared with the numbers enlisted in the previous year, but, notwithstanding this large decrease, the total strength of the Militia on the 1st of January this year, was only 4,938 men short of the numbers on the 1st of January 1894. The causes for this decrease in the number of recruits raised in 1894 were :—

(*a.*) The suspension of the enlistment of growing lads between the age of 17 and 18 in January, February, and part of March.

(*b.*) The raising of the standard of height in most Regiments and Battalions during the above period to very nearly the same as that for the Regular Army.

(*c.*) The re-arrangement of Recruits' Bounties, which is to the effect that they now receive only 10*s.*, instead of 1*l.*, on being dismissed to their homes after completing their drill on enlistment.

(*d.*) The stricter inquiries that were ordered to be made by recruiting officers into the recruit's antecedents, the result being that the percentage of recruits absent from training last year fell from 23·1 to 18·9.

Nationalities and arms.

Table XVIII. shows the number of recruits raised during the past five years, classed according to their nationalities, and the several Arms of the Militia for which they were enlisted.

Table XVIII.

		1890.	1891.	1892.	1893.	1894.
Nationalities	English Militia -	27,210	30,812	37,806	35,538	25,008
	Scotch „ -	3,983	3,903	5,354	4,665	3,640
	Irish „ -	4,441	5,068	5,614	5,568	4,557
	Total - -	35,634	39,783	48,774	45,771	33,205
Arms	Artillery Militia -	3,237	3,586	4,180	4,179	3,102
	Engineer „ -	800	871	531	576	506
	Infantry „ -	31,597	35,326	43,939	40,641	29,109
	Militia Medical Staff Corps.	—	—	124	375	488
	Total - -	35,634	39,783	48,774	45,771	33,205

41. The following are the opinions given by Inspecting Officers as to the physique of the Militia recruits in the ranks at the time of the annual inspection, viz.:— Quality of Recruits.

Excellent	3	161 favourable.
Very satisfactory	6	
Very good	25	
Satisfactory	9	
Good	76	
Fairly good	9	
Very fair	10	
Fair	14	
Average	2	
Strong, strong and healthy, well developed	3	
Well set up, improved	2	
Well grown and promising	2	
Moderate	1	5 unfavourable.
Indifferent, somewhat indifferent	2	
Small, but likely to develop	1	
Small	1	
Total number of units whose recruits were inspected	166	

42. The following table shows the enrolled strength of the Militia on the 1st of January for the past five years, the number of deserters struck off during each year, and the percentage of such deserters on the numbers enrolled. Enrolled strength and deserters.

Table XIX.

Years.	Total Effectives on 1st of Jan. in each year	Deserted during the year.	Rejoined from Desertion.	Net loss by Desertion.	Percentage to Effective Strength.
1890	103,635	8,903	815	8,088	8·6
1891	101,820	10,706	1,034	9,672	10·5
1892	102,032	12,330	1,257	11,073	12·1
1893	108,288	14,048	1,489	12,559	12·9
1894	113,330	10,507	1,380	9,127	9·3

43. The best period of the year to show the real state of the Militia is at the time of the annual trainings, for we can then see the numbers that are actually available, as compared with those enrolled. The following table, therefore, shows, for the last five years, the percentage of absentees from the annual trainings of Militiamen generally, and also of the recruits raised since the training of the preceding year. The figures on the whole are satisfactory, inasmuch as they indicate a diminution in the number of absentees from recent trainings both of the older Militiamen and of the recruits enlisted during the year preceding the training. Notwithstanding this diminution, the fact remains that at last year's training the total number of absentees without leave amounted to 10,231 Militiamen, or 8·7 per cent. of the total strength. It will be seen from the table that this number includes 3,776 recruits who enlisted since the training of the previous year, or 18·9 per cent. of the recruits raised. Enrolled strength at trainings and absentees therefrom.

Table XX.

Years.	Militiamen generally (*including* Recruits raised since Training of previous year).					Recruits raised since the Training of previous year.				
	Number enrolled.	Present at Training.	Excused Training or Absent with Leave.	Absent without Leave from Training.	Percentage of Absentees without Leave.	Number finally Approved.	Casualties between final Approval and Training.	Recruits remaining after deducting Casualties in preceding Column.	Absent without Leave from Training.	Percentage of Absentees without Leave.
1890	109,619	96,437	4,544	8,638	7·9	31,323	14,501	16,822	2,251	13·4
1891	108,735	93,550	5,038	10,147	9·3	34,983	15,983	19,000	3,672	19·3
1892	112,984	95,887	5,768	11,329	10·0	41,445	19,522	21,923	4,671	21·3
1893	121,341	102,979	5,104	13,258	10·9	46,733	19,004	27,729	6,408	23·1
1894	118,397	100,808	*7,358	10,231	8·7	35,523	15,581	19,942	3,776	18·9

* The large number (7,358) excused from training last year is accounted for by the training of two Battalions of the Essex Regiment being dispensed with, on account of an outbreak of small-pox.

Modification of bounties of recruits.

44. The bounty, for the first year of service, of a Militiaman who elects to drill on enlistment is 2*l*., of which, until recently, 1*l*. was given to him on the termination of his drill and 1*l*. after the first annual training. It was, however, found that a large proportion of the recruits who underwent their drill, chiefly during the winter months, did not appear at the annual training. At the training of 1893 the proportion of recruits absent was over 23 per cent., and it was therefore decided to modify the system under which the bounties were paid, and instructions were issued that recruits who were enlisted after the 1st of May 1894 should receive only 10*s*. at the termination of their recruit's drill, the payment of the remaining 30*s*. being deferred until the annual training. The new regulation has not been in force sufficiently long to gauge the full effect of the change, but it is gratifying to note that the percentage of absentee recruits from last year's training was only 18·9 per cent. as compared with 23·1 per cent. in the preceding year.

Modification of bounties of trained Militiamen.

45. During the past year, a further change of some importance was effected in the mode of payment of the bounty allowed to Militiamen on re-engagement or re-enlistment during the non-training period. This bounty, amounting to 30*s*. to each man, was, until recently, paid at the time of re-engagement or re-enlistment, but it was found that a considerable number of the re-engaged men did not appear at the subsequent training, and it was therefore decided to defer the payment of the bounty until they came up for the annual training; and under the present regulation, which came into force on the 1st of June last, the man receives 10*s*. on presenting himself for drill or training, and the remaining 20*s*. at the termination of the training. If he re-engages during the last training of his engagement he receives the full bounty at once.

Numbers present at training.

46. From the foregoing Table XX. it will be seen that, although the enrolled strength of the Militia at the trainings of last year was about 3,000 less than the strength at the corresponding period of 1893, the number actually present at the trainings of 1894, or excused from attendance, was slightly above the numbers of the preceding year, which must be considered very satisfactory, and it is hoped that at the trainings of this year the numbers present will compare still more favourably with the numbers on paper.

Re-enlistments and re-engagements.

47. Table XXI. below shows, for the last five years, (1) the number of men serving on the 1st of January in each year who have re-engaged after not less than five years' service in the Militia; (2) the number who have re-enlisted in the Militia after the completion of at least one engagement of six years, and (3) the number of men who, having served in the Regular Army, have re-enlisted for service in the Militia after their discharge. The falling off in numbers in these classes of Militiamen is probably owing to the modification in the payment of re-engagement and re-enlistment bounties, as explained in the two preceding paragraphs.

Table XXI.

Class.	Serving in the Militia on				
	1st Jan. 1891.	1st Jan. 1892.	1st Jan. 1893.	1st Jan. 1894.	1st Jan. 1895.
(1.) Re-engaged Militiamen -	32,127	33,108	34,010	35,225	33,588
(2.) Militiamen who re-enlisted after completion of engagement	6,631	7,488	5,888	7,446	6,659
(3.) Discharged soldiers - -	6,478	6,905	6,866	7,816	7,535
Total - -	45,236	47,501	46,764	50,487	47,782
Percentage on the enrolled strength.	44	47	43	45	44

48. The subjoined table XXII. shows the state of the Submarine Mining Militia on the 1st January during the past five years, the present establishment of the force, and the numbers wanting or supernumerary in each division. Submarine Mining Militia.

Table XXII.

Divisions.	Total Effectives on the 1st January in each year.				On 1st January 1895.		
	1891.	1892.	1893.	1894.	Effectives.	Establishment.	Wanting or supernumerary.
Portsmouth	209	204	153	69	64	72	− 8
Needles	—	—	—	50	44	49	− 5
Plymouth	171	163	140	91	83	70	+13
Falmouth	—	—	—	14	62	70	− 8
Thames	247	302	131	69	79	77	+ 2
Medway			94	69	60	58	+ 2
Harwich	57	57	49	56	59	50	+ 9
Milford Haven	49	69	64	43	46	60	−14
Western	103	218	125	92	76	90	−14
Humber	—	—	48	68	66	70	− 4
Total	836	1,013	804	621	639	666	−27

49. The Militia Medical Staff Corps consists of three companies, the Hants company raised in 1891, the Middlesex in 1893, and the Surrey company in 1894. The establishment of the corps is 293, and the enrolled strength of non-commissioned officers and men on the 1st of January this year was 302. It is a popular corps, and there is no difficulty in keeping it up to full numbers. The standard of height for the Militia Medical Staff Corps was formerly the same as for other Militia, viz. :—5 ft. 3 ins. and upwards, but in the latter part of last year the maximum height was fixed at 5 ft. 6 ins., to bring it more in accordance with the standard for the Medical Staff Corps, which is 5 ft. 3 ins. to 5 ft. 5 ins. The standard is not, however, insisted on in the case of skilled men. apothecaries, medical attendants, &c. Militia Medical Staff Corps.

50. Details of the service and age of Militiamen who joined the Regular Army during 1894 and the four preceding years are given in Table XXIII. below. Enlistments into the Regular Army.

Table XXIII.

—	1890.	1891.	1892.	1893.	1894.
No. who had not served a training	7,392	8,027	9,681	8,998	7,585
No. who had served one training	3,476	3,724	4,000	3,647	3,696
No. who had served two or more trainings.	1,794	1,791	1,978	1,669	1,983
Total	12,662	13,542	15,659	14,314	13,264
Under 20 years of age	10,080	10,262	11,573	10,336	9,855
Over 20 years of age	2,582	3,280	4,086	3,978	3,409
Total	12,662	13,542	15,659	14,314	13,264

Comparison of effectives and establishment.

51. Table XXIV. shows the comparative strength and establishment of the English, Scotch, and Irish, Militia on the 1st of January for the past five years, and the percentage of the numbers short of the establishment in each year.

TableXXIV.

Years.	Countries.	Non-Commissioned Officers and Men. On the 1st of January in each year. Effectives.	Establishment.	Number wanting.	Percentage of Number wanting to Establishment.	Increase or Decrease during the year. Increase.	Decrease.
1891	English Militia -	68,325	84,603	16,278	19·2	—	—
	Scotch ,, -	12,156	14,764	2,608	17·6	—	—
	Irish ,, -	21,339	28,168	6,829	24·2	—	—
	Total -	101,820	127,535	25,715	20·1	—	—
1892	English Militia -	68,197	84,815	16,618	19·6	—	128
	Scotch ,, -	12,290	14,658	2,368	16·1	134	—
	Irish ,, -	21,545	28,072	6,527	23·2	206	—
	Total -	102,032	127,545	25,513	20·0	212	—
1893	English Militia -	72,906	83,804	10,898	13·0	4,709	—
	Scotch ,, -	13,535	14,658	1,123	7·6	1,245	—
	Irish ,, -	21,847	28,026	6,179	22·0	302	—
	Total -	108,288	126,488	18,200	14·4	6,256	—
1894	English Militia -	76,957	83,821	6,864	8·2	4,051	—
	Scotch ,, -	13,888	14,656	768	5·2	353	—
	Irish ,, -	22,485	28,026	5,541	19·8	638	—
	Total -	113,330	126,503	13,173	10·4	5,042	—
1895	English Militia -	72,782	83,919	11,137	13·3	—	4,175
	Scotch ,, -	13,281	14,752	1,471	10·0	—	607
	Irish ,, -	22,329	28,026	5,697	20·3	—	156
	Total -	108,392	126,697	18,305	14·4	—	4,938

Although the number of effectives is higher than it was in 1891, 1892, or 1893, there is a considerable decrease compared with 1894. This is attributable, no doubt, to the restrictions placed on recruiting, the re-arrangement of bounties, and the stricter inquiries made into the antecedents of recruits, as explained in paragraphs 40, 44, and 45. All changes affect recruiting more or less, but it is anticipated that this decrease will be but temporary, and that we may look for an improvement in the present year.

Increase and decrease.

52. In Appendix E. will be found a table showing the details of the increase and decrease of the Militia during the last five years, and the numbers enrolled on the 1st of January in each year.

PART IV.

Militia Reserve.

Establishment and qualifications.

53. The quota of Militiamen who may be enlisted in the Militia Reserve is based upon a certain proportion of the fixed Militia establishment. The full number of the Militia Reserve is always well maintained, since, as a rule, more men come forward for enlistment than can be taken. The qualifications are nearly the same as for the Regular Army, except that the men must have attained the age of 19, and have served at least two trainings. Their period of Reserve engagement coincides with their Militia

engagement, and they may be re-engaged or re-enlisted up to the age of 34. The establishment of the Militia Reserve is as follows:—

One-third of the establishment of Gunners in the Artillery.
One-fourth of the establishment of Sappers in the Engineers.
One-fourth of the establishment of Privates in the Infantry.
One-half of the establishment of Privates in the Medical Staff Corps.

Numbers enlisted.

54. The annexed Table XXV. shows the establishment and strength of the Militia Reserve on the 1st of January for the past five years:—

Table XXV.

Militia Reserve.	1891.	1892.	1893.	1894.	1895.
Establishment - -	30,000	30,000	30,000	30,000	30,000
Enrolled Strength - -	30,245	30,171	30,417	30,103	30,259

Increase and decrease.

55. In Appendix **E.** will be found a table showing the increase and decrease of the Militia Reserve, during the year 1894, by Countries and Arms of the Service.

PART V.

Civil Employment.

Civil employment of ex-soldiers a State question.

56. As recruiting now is so largely influenced by the amount of civil employment found for soldiers on their leaving the Colours, it may not be out of place to devote a portion of this report to the means existing for finding situations in civil life for ex-soldiers. This has become more or less a public question, and it is now generally admitted that, if the number and quality of recruits required annually are to be obtained, it will be important the soldier should have a fair prospect, if he behaves well, of gaining a livelihood when his services are dispensed with. I propose, therefore, to submit a few remarks on this important subject.

Military employment associations.

57. In all Regimental and Recruiting districts there exists an association for finding employment for Discharged Soldiers, Reservists, and Pensioners, who have left the Colours with a good character. In addition to these, other branches of the Army, the Brigade of Guards, and some Regiments, have their several employment associations distinct from those in Regimental districts. These associations, although they may be said to be more or less on a military footing, since the registers are kept by officers on full pay, are self-supporting and receive no State aid, but it is very gratifying to observe that in nearly all of them county gentlemen, clergymen of all denominations, and other influential civilians, have come forward to serve on the committees of management, and their aid and influence have proved most valuable. Certain rules have been laid down for the guidance of these associations as to the registration of ex-soldiers, it being particularly impressed upon the officers in charge that only well-conducted men should be registered, as it is found by experience that the misconduct of one man whilst in civil employ does immense harm to the cause, since he acts as a deterrent to the employment of many others.

Civil employment associations.

58. The principal Civil Association is the "National Association for the Employment of Reserve Soldiers, &c," under the presidency of General Sir John Adye, G.C.B. Its head-quarters are in London, but it is affiliated with 73 other associations in the United Kingdom, many of these being Regimental and Recruiting District Associations. It is principally supported by voluntary subscriptions, aided by annual grants from public funds. It is doing excellent work, and has, year by year, found employment for an increasing number of men. The "Army and Navy Pensioners Employment Society" has also done good work. It has branches in London, Dublin, and Glasgow, and is kept up entirely by voluntary subscriptions, the expenses amounting to about 600*l.* a year.

Steps taken to provide employment in past years.

59. It may be interesting to note the successive steps taken in past years to provide employment for deserving soldiers on their leaving the Colours, these may be briefly summarised as follows :—

(*a.*) In 1876–77 the question was considered by a Committee of the House of Commons.

(*b.*) In 1883 a Committee appointed by the Treasury reported in favour of employing pensioners in the Civil Service.

(*c.*) In 1884 the War Office ordered registers to be kept in Regimental Districts.

(*d.*) In 1885 the National Association for the Employment of Reservists and Discharged Soldiers was established. It has received an annual subscription from the State since its formation.

(*e.*) In February 1888 His Royal Highness the Commander-in-Chief addressed a letter to the Secretary of State for War, mentioning the efforts made by the National Association for the employment of Reserve and Discharged Soldiers, and by the Officers in charge of Regimental District Registers, and urging that the subject be brought to the notice of the Government, with a view to preference being given to ex-soldiers when filling up vacancies, in the several Departments of the State, for which they are eligible, such as writers, messengers, porters, gate-keepers, letter-carriers, &c. The Secretary of State circulated this letter to Government Departments with a strong expression of his hope that His Royal Highness's request would be complied with.

(*f.*) In 1891, 1892, 1893, and 1894 various arrangements were made by successive Postmasters-General.

(*g.*) In 1892 the managers of the principal railway companies agreed, at a conference held at the War Office, to accept Reservists and Discharged Soldiers for employment as porters, messengers, gate-keepers, &c. It was calculated that the railway companies would be able to give employment to about 2,000 men per annum.

(*h.*) During 1892 and 1893 voluntary associations were formed in Regimental and Recruiting Districts for the purpose of furthering the objects for which employment registers were kept in those districts.

(*i.*) In May 1893 a second Treasury Committee recommended that the posts of messengers, porters, gate-keepers, and fire-lighters should be filled by pensioners in all State Departments. The Treasury concurred, and promised to recommend this to other Departments, and try it in their own.

(*j.*) On the 17th of July 1894 a Select Committee of the House of Committee assembled to consider the question of the employment of ex-soldiers and sailors. On the 3rd of August the Committee reported the evidence taken, and recommended that a committee on the same subject be appointed in the next Session of Parliament.

Result of the steps taken to provide civil employment.

60. The result of the steps taken, as detailed in the preceding paragraph, may be gleaned from the following table :—

Table XXVI.

Years.	Number on the Official Registers for Employment.	Number for whom Employment was found by means of the Official Registers, and who have accepted the Appointments offered.			
		In the Post Office.	In other Government Appointments.	In Civilian Firms, Companies, &c.	Total Men for whom Employment was Found and Accepted.
June 1884 to Oct. 1887	5,010	No information available.			351
1888	No information available.			—	—
1889	"	"		—	—
1890	1,449	No information available.			143
1891	No information available.			—	—
1892	5,642	1,230	57	910	2,197
1893	6,775	979	111	1,824	2,914
1894	7,827	715	98	2,274	3,087

The men remain on the registers until it is notified that they have obtained employment. Many men who obtain employment for themselves do not notify this to the officer in charge of the register, and are, therefore, kept on the books for a considerable time.

Employment in the Post Office.

61. The Post Office is the largest employer of labour of all the State Departments, and it is the Department in which the largest number of discharged soldiers and reservists can be usefully employed. It is hoped that in future this Department will be able to set apart a certain fixed proportion of appointments annually for deserving soldiers. It is regrettable that the number of posts in this Department annually offered to old soldiers shows a tendency to decrease.

Suggestions for the employment of ex-soldiers by State Departments.

62. The best way of opening out State employment to ex-soldiers is, in my opinion, to give instructions that a certain percentage of vacancies in each department be reserved annually for the Army. Clear regulations should be laid down as to the required conditions, viz. :—age, height, education, length of service, &c., &c., in order to avoid disappointment to men registering themselves for appointments for which they afterwards find they are not eligible. In laying down the age qualification, advantage should be given to the ex-soldier, since very few men leave the service under 25, and the majority are over 26. Men should enter into civil employment as soon as possible after leaving the Colours, and then their Army character should be

deemed sufficient. Even very steady men find it difficult to get good references if they have been unemployed for several months. If this course were adopted, there would be nothing to prevent men from going straight from the Colours to the Post Office or other Government Department.

PART VI.

General Observations.

63. The following tables show the results of recruiting for the Regular Army and Militia for the past five years :— Results of Recruiting.

Results of Recruiting in England, Wales, Scotland, and Ireland, during the past five years. Table XXVII.

—	1890.		1891.		1892.		1893.		1894.	
	Regular Army.	Militia.	Regular Army.	Militia.	Regular Army.	Militia.	Regular Army.	Militia.	Regular Army.	Militia.
England and Wales -	24,846	27,210	28,863	30,812	32,094	37,806	28,444	35,538	26,763	25,008
Scotland - -	2,485	3,983	3,036	3,903	3,567	5,354	3,046	4,665	3,232	3,640
Ireland - -	3,587	4,441	3,447	5,068	3,860	5,614	3,357	5,568	3,446	4,557
Total -	30,918	35,634	35,346	39,783	39,521	48,774	34,847	45,771	33,441	33,205

Results of Recruiting by the various Agencies in the United Kingdom, during the past five years. Table XXVIII.

—	1890.		1891.		1892.		1893.		1894.	
	Regular Army.	Militia.	Regular Army.	Militia.	Regular Army.	Mil.tia.	Regular Army.	Militia.	Regular Army.	Militia.
Regimental Districts	19,920	27,696	22,799	30,543	23,954	35,216	19,133	31,596	18,041	21,551
Militia and Volunteer Artillery Districts	2,980	3,793	3,433	3,931	3,294	3,890	2,885	3,896	2,138	2,742
Engineer Districts -	—	—	187	—	184	531	143	576	180	506
Recruiting Districts -	6,462	3,263	7,019	3,949	10,150	7,992	10,767	8,289	11,428	7,925
Head-quarters of units	1,556	—	1,908	—	1,939	1,145	1,919	1,414	1,654	481
Agencies not stated -	—	882	—	1,360	—	—	—	—	—	—
Total - -	30,918	35,634	35,346	39,783	39,521	48,774	34,847	45,771	33,441	33,205

64. The principal change made, during the past year, was the amalgamation, on the 1st of August, of the two appointments of Inspector General of Recruiting and of Deputy Adjutant General for Militia, Yeomany, and Volunteers, under one General Officer, called "Inspector General of Auxiliary Forces and Recruiting." An Assistant Adjutant General for Recruiting was, at the same time, appointed, in addition to the existing Deputy Assistant Adjutant General for Recruiting. The number of officers, therefore, in the combined departments remains the same. Changes in the Head-quarter Staff.

65. The only other change in the Recruiting Staff was made in the Home District, viz., the appointment of a "Chief Recruiting Staff Officer" for the London Recruiting District in place of an Assistant Adjutant General for Recruiting. This was a change of title only, since the duties remain the same, viz., the supervision of recruiting in the Metropolis. Changes in the Home District Recruiting Staff.

Recruiting Regulations.

66. The Recruiting Regulations have been revised, and will shortly be issued. The duties of Recruiting Staff Officers have been more clearly defined, and the "Schedule of Age, Height, Weight, and Chest Measurement" has been added as an appendix, instead of being published separately.

Recruiting in Ireland.

67. The Field Marshal Commanding the Forces in Ireland remarks, in his annual Report on Recruiting, that the quality of recruits for both the Regular Army and Militia is improving, and that this is borne out by the satisfactory reports he has received during the past year as to their physique, education, and conduct. He also remarks that the care which is now taken by recruiting officers to inquire into the antecedents of men offering for enlistment has tended very considerably to reduce the numbers of undesirable characters, who would otherwise be now serving. These remarks are confirmatory of the opinions generally expressed in other parts of the United Kingdom.

Summary.

68. Taking everything into consideration, recruiting for the Army during the past year may be considered perfectly satisfactory as regards numbers, since we have enlisted up to our full establishment. It is also satisfactory to note that there has been a considerable diminution in the number of men discharged as invalids under two years' service, and also in the waste by desertion. The Army, as before mentioned, is becoming more popular with all classes, and consequently the social position of our recruits is gradually improving. Their physique is as good as can be expected at present, considering that, in order to get the numbers required, 20 to 25 per cent. have to be enlisted under regulation standard, but the development of these growing lads, after a few months' service, is remarkable, and will be still more so, I hope, if the proposed new course of free gymnastics for recruits, to take place immediately after their enlistment, is introduced. This, combined with the improved system of cooking, and other beneficial changes connected with the soldier's food, must in time have a good effect on the general physique of the whole Army.

Strength of the Army, Auxiliary Forces, and Reserves.

69. The strength of the Regular Army, the Militia, Volunteers, and 1st and 2nd Class Army Reserve, on the 1st of January 1895, compared with the previous 10 years, will be found in Appendix G.

I have the honour to be,
Sir,
Your obedient Servant,
F. W. Grenfell,
Major-General,
Inspector General of Recruiting.

The Adjutant General to the Forces,
&c., &c., &c.,
Horse Guards, War Office.

APPENDICES.

APPENDIX A.

RETURN showing the number of Recruits raised for the Regular Army by agencies under the orders of the Officer Commanding each Regimental District, Militia and Volunteer Artillery District, Engineer District, and Recruiting District, and those enlisted for the Militia of the Territorial Regiment, during the year 1894, also the number of men serving in the Territorial Regiment on the 1st January 1895 who were born in the Regimental District.

Regimental District.	Head-Quarters of District.	Commanding Officer.	Date of Appointment.	Finally approved for the Regular Army.			Militia.	Number in Territorial Regiment on 1st Jan, 1895 born in the Regimental District.
				For the Territorial Regiment of the District.	For Other Corps.	Total.		
ENGLAND.								
2nd Regt. Dist.	Guildford	Col. Holt	22 Oct. 1892	175	223	398	430	823
3rd " "	Canterbury	" Kerr	17 Oct. 1892	182	108	290	166	1,027
4th " "	Lancaster	" Kidston	2 Jan. 1893	100	77	177	219	987
5th " "	Newcastle-on-Tyne	" Upcher	8 April 1894	104	97	201	238	311
6th " "	Warwick	" Mair	17 Oct. 1892	115	73	188	163	1,303
7th " "	Hounslow	" Hussey	17 April 1894	194	269	463	177	1,175
8th " "	Warrington	" Eyre-Williams	10 Oct. 1892	151	107	258	263	950
9th " "	Norwich	" Perry	26 Mar. 1890	228	63	291	443	1,203
10th " "	Lincoln	" Glen	17 April 1894	149	86	235	349	600
11th " "	Exeter	" Home	7 May 1890	178	65	243	330	913
12th " "	Bury St. Edmunds	" Collins	12 May 1890	297	93	390	659	1,588
13th " "	Taunton	" Thompson	4 June 1891	208	231	439	484	1,021
14th " "	York	" Harington	1 April 1893	77	77	154	113	727
15th " "	Beverley	" Hallowes*	25 Feb, 1890	50	32	82	71	281
16th " "	Bedford	" Lee	1 Sept. 1892	259	96	355	534	1,189
17th " "	Leicester	" Langtry	4 Mar. 1891	260	87	347	305	705
19th " "	Richmond, Yorkshire	" Lawson	30 Aug. 1894	118	69	187	261	718
20th " "	Bury, Lancashire	" Baker	30 June 1891	353	251	604	803	1,458
22nd " "	Chester	" Butlin	30 Aug. 1894	213	129	342	405	501
23rd " "	Wrexham	" Wilson	3 June 1894	84	11	95	130	367
24th " "	Brecon	" Bromhead	13 Feb. 1892	148	48	196	487	598
28th " "	Bristol	" Salis-Schwabe	18 Jan. 1890	231	312	543	386	1,249
29th " "	Worcester	" Temple	19 Dec. 1892	240	135	375	305	1,080
30th " "	Burnley	" Griffiths	12 June 1893	61	64	125	137	1,020
31st " "	Kingston on-Thames	" Hornby	1 Dec. 1891	143	462	605	698	1,028
32nd " "	Bodmin	" Gillies	7 Mar. 1893	89	55	144	132	305
33rd " "	Halifax	" Fenn	27 Jan. 1891	201	124	325	321	843
34th " "	Carlisle	" Hilton	27 Aug. 1893	109	48	157	171	373
35th " "	Chichester	" Tolson	3 Nov. 1893	148	179	327	313	1,495
37th " "	Winchester	" Whitting	12 April 1891	143	204	347	254	1,416
38th " "	Lichfield	" Raper	12 Nov. 1892	259	72	331	286	1,209
39th " "	Dorchester	" Tweedie	1 April 1892	160	66	226	267	633
40th " "	Warrington	" Eyre-Williams	10 Oct. 1892	170	46	216	277	1,195
41st " "	Cardiff	" Goldsmid	21 April 1894	133	198	331	300	937
43rd " "	Oxford	" Livesay	10 Nov. 1892	221	120	341	532	661
44th " "	Warley	" Maguire	1 April 1890	279	255	534	598	1,374
45th " "	Derby	" Hooke	28 Aug. 1890	308	224	532	416	1,061
47th " "	Preston	" McCleverty	21 July 1893	177	82	259	225	1,215
48th " "	Northampton	" Maclean	21 April 1894	149	71	220	238	755
49th " "	Reading	" Borrett	10 Mar. 1890	197	99	296	323	1,192
50th " "	Maidstone	" Bayly	12 July 1894	142	44	186	220	829
51st " "	Pontefract	" Luck	1 April 1892	171	72	243	198	1,034
53rd " "	Shrewsbury	" Cary	27 Sept. 1893	175	51	226	296	905
57th " "	Hounslow	" Hussey	17 April 1894	49	330	379	209	1,250
62nd " "	Devizes	" Collingwood	3 April 1893	148	35	183	256	1,029
63rd " "	Ashton-under-Lyne	" Græme	12 July 1893	65	26	91	141	479
64th " "	Lichfield	" Raper	12 Nov. 1892	250	51	301	366	1,168
65th " "	Pontefract	" Luck	1 April 1892	167	126	293	228	785
68th " "	Newcastle-on-Tyne	" Upcher	8 April 1894	174	146	320	479	585
		Total (English Regimental Districts)		8,402	5,989	14,391	15,602	45,550

* This officer vacated the command of the District on 19th December 1894.

APPENDIX A.—*continued.*

Districts.	Head-Quarters of District.	Commanding Officer.	Date of Appointment.	Finally approved for the Regular Army. For the Territorial Regiment of the District.	Finally approved for the Regular Army. For Other Corps.	Finally approved for the Regular Army. Total.	Militia.	Number in Territorial Regiment on 1st Jan. 1895 born in the Regimental District.
SCOTLAND.								
1st Regt Dist.	Glencorse	Col. Bridge	25 Feb. 1893	92	33	125	230	589
21st „ „	Ayr	„ Jackson	21 Jan. 1891	66	35	101	140	237
25th „ „	Berwick-on-Tweed	„ Carwithen	1 April 1890	54	27	81	157	620
26th „ „	Hamilton	„ Lynch	17 Mar. 1892	87	180	267	389	366
71st „ „	„			61	136	197	363	616
42nd „ „	Perth	„ Wallace	23 July 1890	136	246	382	339	749
72nd „ „	Fort George	„ Gordon	6 June 1894	64	16	80	172	425
75th „ „	Aberdeen	„ Boyes	1 April 1892	146	56	202	122	513
79th „ „	Inverness	„ Gordon	6 June 1894	25	8	33	181	203
91st „ „	Stirling	„ Sunderland	6 Dec. 1892	102	81	183	370	323
		Total (Scotch Regimental Districts)		833	818	1,651	2,663	4,641
IRELAND.								
18th Regt Dist.	Clonmel	Col. Webber	3 Nov. 1892	174	137	311	439	997
27th „ „	Omagh	„ Stockley	12 July 1892	66	29	95	277	567
83rd „ „	Belfast	„ Dawson	22 Oct. 1892	229	137	366	604	958
87th „ „	Armagh	„ Dooner	19 April 1894	80	41	121	263	504
88th „ „	Galway	„ Cochran	21 June 1894	217	62	279	359	693
100th „ „	Birr	„ Crawford	25 Nov. 1891	95	71	166	357	497
101st „ „	Tralee	„ Barnard	26 Oct. 1894	232	221	453	860	1,282
102nd „ „	Naas	„ Leggett	20 June 1894	135	73	208	127	1,123
		Total (Irish Regimental Districts)		1,228	771	1,999	3,286	6,621
Militia & Volunteer Artillery Districts.	Scarboro'	Lieut. Col. Robinson	1 April 1890	—	136	136	271	—
	Liverpool	„ Dunnage	1 Jan. 1894	—	220	220	64	—
	Great Yarmouth	„ Gregory	1 Oct. 1891	—	489	489	219	—
	Dover	„ Ditmas	17 Aug. 1891	—	372	372	262	—
	Gosport	„ Ferrier	30 May 1891	—	112	112	45	—
	Devonport	„ Browne	27 June 1894	—	262	262	620	—
	Leith	„ Alves	12 Mar. 1892	—	67	67	365	—
	Aberdeen	„ Will	22 Feb. 1894	—	44	44	145	—
	Londonderry	Col. Perry	28 May 1890	—	152	152	391	—
	Templemore	Lieut.-Col. Tabor	22 April 1893	—	284	284	360	—
		Total (Artillery Districts)		—	2,138	2,138	2,742	—
Engineer Districts	York	Col. Brooke	6 Nov. 1894	—	4	4	30	—
	Chester	„ Slacke	1 Dec. 1891	—	28	28	98	—
	Colchester	„ Ferguson	24 Jan. 1890	—	14	14	16	—
	Devonport	„ Bell	6 Nov. 1894	—	45	45	311	—
	Gosport	„ Fraser	1 Sept. 1894	—	30	30	9	—
	Edinburgh	„ Patten	2 Feb. 1894	—	4	4	—	—
	Chatham (S.M.E.)	„ Todd	5 Oct. 1892	—	55	55	42	—
		Total (Engineer Districts)		—	180	180	506	—
Recruiting Districts	London	Col. Brind	18 Sept. 1894	—	5,629	5,629	4,543	—
		Lieut.-Col. Brownrigg	31 July 1892					
		Capt. Gordon	25 Mar. 1894					
	Liverpool	„ Christopher	15 April 1892	—	468	468	230	—
	Dublin	Lieut.-Col. Willoughby	1 Feb. 1894	—	843	843	520	—
	Leeds	„ Stevenson	4 April 1892	—	506	506	480	—
	Manchester	„ Railston	1 April 1892	—	699	699	574	—
	Birmingham	„ Cameron	12 Nov. 1892	—	794	794	514	—
	Woolwich	„ Moore	4 April 1892	—	656	656	360	—
	Newport (Mon.)	„ Dutton	20 Nov. 1893	—	406	406	237	—
	Glasgow	„ Tupper	31 Aug. 1893	—	947	947	209	—
	Edinburgh	Capt. Sinclair	6 April 1892	—	480	480	267	—
		Total (Recruiting Districts)		—	11,428	11,428	7,925	—

N.B.—The above does not include recruits raised at the Head Quarters of Regiments, Battalions, and Batteries, or those enlisted for the Militia Medical Staff Corps.

APPENDIX B.

RETURN showing the number of Recruits raised for the Regular Army by agencies under the orders of the Officer Commanding each Regimental District, Militia and Volunteer Artillery District, Engineer District, and Recruiting District, during the last five years.

Regimental Districts.	Head-Quarters of District.	Finally approved for Regular Army.				
		1890.	1891.	1892.	1893.	1894.
ENGLAND.						
2nd Regimental District	Guildford	348	475	397	379	398
3rd " "	Canterbury	273	340	394	306	290
4th " "	Lancaster	215	159	184	130	177
5th " "	Newcastle-on-Tyne	305	433	449	281	201
6th " "	Warwick	1,206	1,543	632	228	188
7th " "	Hounslow	352	343	442	454	463
8th " "	Warrington	122	164	338	301	258
9th " "	Norwich	267	283	273	236	291
10th " "	Lincoln	109	169	267	263	235
11th. " "	Exeter	336	256	237	172	243
12th " "	Bury St. Edmunds	210	224	225	322	390
13th " "	Taunton	325	262	361	410	439
14th " "	York	296	302	300	91	154
15th " "	Beverley	92	111	102	102	82
16th " "	Bedford	259	198	340	367	355
17th " "	Leicester	417	528	371	331	347
19th " "	Richmond, Yorkshire	185	166	294	219	187
20th " "	Bury, Lancashire	547	605	918	633	604
22nd " "	Chester	225	341	305	289	342
23rd " "	Wrexham	164	121	168	138	95
24th " "	Brecon	205	231	340	263	196
28th " "	Bristol	824	812	821	724	543
29th " "	Worcester	348	395	515	386	375
30th " "	Burnley	181	260	312	142	125
31st " "	Kingston-on-Thames	369	839	953	743	605
32nd " "	Bodmin	86	117	149	172	144
33rd " "	Halifax	366	464	454	382	325
34th " "	Carlisle	108	108	128	108	157
35th " "	Chichester	390	405	355	267	327
37th " "	Winchester	581	530	530	516	347
38th " "	Lichfield	214	348	507	400	331
39th " "	Dorchester	228	233	297	235	226
40th " "	Warrington	203	270	308	208	216
41st " "	Cardiff	221	314	693	506	331
43rd " "	Oxford	256	260	238	375	341
44th " "	Warley	506	541	631	461	534
45th " "	Derby	579	559	758	532	532
47th " "	Preston	410	378	366	357	259
48th " "	Northampton	355	352	315	240	220
49th " "	Reading	233	371	397	376	296
50th " "	Maidstone	197	260	190	179	186
51st " "	Pontefract	237	295	386	207	243
53rd " "	Shrewsbury	191	239	279	269	226
57th " "	Hounslow	274	294	382	491	379
62nd " "	Devizes	176	170	205	212	183
63rd " "	Ashton-under-Lyne	941	1,015	556	227	91
64th " "	Lichfield	346	311	445	385	301
65th " "	Pontefract	241	460	569	363	293
68th " "	Newcastle-on-Tyne	204	472	631	401	320
Total (English Regimental Districts)		15,723	18,326	19,707	15,779	14,391

APPENDIX B.—*continued.*

Districts.	Head Quarters of District.	Finally approved for Regular Army.				
		1890.	1891.	1892.	1893.	1894.
SCOTLAND.						
1st Regimental District	Glencorse	296	535	319	148	125
21st " "	Ayr	95	102	140	125	101
25th " "	Berwick-on-Tweed	47	54	97	123	81
26th " "	Hamilton	528	609	382	173	267
42nd " "	Perth	275	236	449	324	382
71st " "	Hamilton	581	642	328	178	197
72nd " "	Fort George	60	56	44	63	80
75th " "	Aberdeen	107	157	150	182	202
79th " "	Inverness	29	15	26	45	33
91st " "	Stirling	203	278	224	203	183
Total (Scotch Regimental Districts)		2,221	2,684	2,159	1,564	1,651
IRELAND.						
18th Regimental District	Clonmel	376	253	307	240	311
27th " "	Omagh	117	105	131	113	95
83rd " "	Belfast	679	511	448	322	366
87th " "	Armagh	128	97	126	165	121
88th " "	Galway	163	126	264	217	279
100th " "	Birr	147	205	231	190	166
101st " "	Tralee	196	279	386	360	453
102nd " "	Naas	170	213	195	183	208
Total (Irish Regimental Districts)		1,976	1,789	2,088	1,790	1,999
Militia and Volunteer Artillery Districts.	Scarboro'	302	288	352	232	136
	Liverpool	107	227	274	179	220
	Great Yarmouth	561	630	585	480	489
	Dover	380	462	544	420	372
	Woolwich	325	503	—	—	—
	Gosport	214	166	117	145	112
	Devonport	195	166	} 510	542	262
	Newport, Mon.	155	251			
	Leith	101	85	98	107	67
	Aberdeen	88	84	80	58	44
	Londonderry	352	281	309	237	152
	Templemore	200	290	425	485	284
Total (Artillery Districts)		2,980	3,433	3,294	2,885	2,138
Engineer Districts	York	No Returns furnished.	4	19	11	4
	Chester		42	24	55	28
	Colchester		16	25	8	14
	Devonport		27	22	25	45
	Gosport		17	14	17	30
	Edinburgh		2	1	4	4
	Chatham		79	79	43	55
Total (Engineer Districts)		—	187	184	143	180
Recruiting Districts	London	5,031	5,537	5,365	5,355	5,629
	Liverpool	509	560	685	527	468
	Dublin	922	922	885	717	843
	Newcastle	Not formed.		32	15	—
	Leeds			347	500	506
	Manchester			599	993	699
	Birmingham			557	850	794
	Woolwich			582	539	656
	Newport, Mon.			—	—	406
	Glasgow			751	922	947
	Edinburgh			347	349	480
Total (Recruiting Districts)		6,462	7,019	10,150	10,767	11,428
Recruiting Districts generally.	English Districts	22,757	26,384	29,238	25,788	24,288
	Welsh "	745	917	1,201	907	1,028
	Scotch "	2,410	2,855	3,436	3,004	3,193
	Irish "	3,450	3,282	3,707	3,229	3,278
Total		29,362	33,438	37,582	32,928	31,787

N.B.—The above does not include recruits raised at the Head Quarters of Regiments, Battalions, and Batteries.

APPENDIX C.

Increase and Decrease of each Arm of the Service during the Year 1894.

	Non-Commissioned Officers and Men.																
	Household Cavalry.	Cavalry of the Line.	Royal Artillery. Horse.	Royal Artillery. Field.	Royal Artillery. Mountain.	Royal Artillery. Garrison.	Royal Engineers.	Foot Guards.	Infantry of the Line.	Colonial Corps.	Army Service Corps.	Ordnance Store Corps.	Corps of Armourers.	Medical Staff Corps.	Army Pay Corps.	Army Post Office Corps.	All Arms.
Effectives on the 1st January 1894	1,232	17,369	3,669	13,921	1,337	16,772	6,351	5,793	132,678	4,048	3,231	785	306	2,471	—	—	210,863
INCREASE:—																	
Recruits joined — Long service	135	88	21	87	4	154	72	25	777	303	20	5	9	9	—	—	1,708
Recruits joined — Short service — 3 years	—	—	—	—	—	—	159	675	—	—	395	—	—	99	—	40	1,368
Recruits joined — Short service — 7 years	—	3,020	248	1,901	—	2,588	580	326	21,598	50	—	77	—	234	—	—	30,622
	135	3,108	269	1,988	4	2,742	811	1,026	22,375	353	415	82	9	341	—	40	33,698
Joined from desertion	3	171	29	180	5	120	23	43	1,280	9	13	2	—	5	—	—	1,883
From Army Reserve	2	4	1	3	—	4	—	5	23	2	—	2	—	4	—	—	50
Other Causes	7	—	229	—	234	—	32	—	—	—	26	10	—	5	*533	—	1,076
Total increase	147	3,283	528	2,121	243	2,866	866	1,074	23,678	364	454	96	9	355	533	40	36,657
DECREASE:—																	
Dead	6	117	40	155	15	147	32	23	1,171	62	9	2	3	10	—	—	1,792
Discharged — After 21 years' service	9	54	12	51	2	108	58	10	213	4	14	4	5	27	7	—	578
Discharged — Prematurely, after 18 years' service under Royal Warrant, 25th June 1881	2	16	3	19	3	27	4	7	79	2	7	1	—	3	2	—	179
Discharged — On completing 1st period	21	37	10	59	5	94	19	11	410	120	4	4	1	3	—	—	708
Discharged — As invalids	26	234	57	201	15	251	44	121	2,015	119	25	7	1	36	—	—	3,152
Discharged — By purchase	24	184	13	63	16	117	14	47	734	6	5	2	—	10	1	—	1,236
Discharged — Under Sec. 81, Army Act of 1881	5	260	18	84	—	57	30	36	713	10	4	—	—	1	—	—	1,218
Discharged — Free by indulgence	5	27	3	32	5	23	2	2	180	6	2	1	—	3	1	—	299
Discharged — Not likely to become efficient soldiers	19	40	7	32	—	51	10	25	206	7	6	—	—	2	—	—	405
Discharged — On conviction of making a false answer on attestation	—	18	1	16	3	18	1	6	108	—	—	—	—	—	—	—	171
Discharged — For misconduct	10	136	25	167	14	171	12	79	1,089	24	30	3	—	30	2	—	1,792
Discharged — Miscellaneous	3	43	8	24	1	34	18	19	436	12	28	4	1	21	—	—	652
	124	1,053	157	748	64	951	212	364	6,189	310	125	26	8	136	13	—	10,480
Struck off as Deserters	12	461	45	209	25	273	26	92	2,647	31	23	3	—	21	—	—	3,958
To Army Reserve — On completion of service	—	1,209	192	727	43	1,116	260	603	10,237	26	248	37	—	98	—	—	14,796
To Army Reserve — On conversion of service	—	198	7	31	—	50	131	62	632	—	132	11	—	36	—	40	1,330
To Army Reserve — Relegated	1	14	—	—	1	8	1	2	75	—	1	—	—	—	—	—	103
To Militia, Yeomanry, and Volunteers	3	9	7	19	3	81	9	4	508	—	—	—	—	1	—	—	644
Given up as deserters	—	13	—	16	2	8	—	2	34	1	—	—	—	—	—	—	76
Other causes	—	8	—	130	—	296	—	8	336	—	—	—	7	—	—	—	786
Total decrease	146	3,083	448	2,125	153	2,930	671	1,160	21,829	430	538	79	18	302	13	40	33,065
Net increase	1	200	80	—	90	—	195	—	1,849	—	—	17	—	53	520	—	2,602
Net decrease	—	—	—	4	—	64	—	86	—	66	84	—	9	—	—	—	—
Effectives on the 1st January 1895	1,233	17,569	3,749	13,917	1,427	16,708	6,546	5,707	134,527	4,382	3,147	802	297	2,524	520	—	213,555

* Brought on regimental establishment on 1st April 1894.

APPENDIX D.

STATE of the ARM (Non-Commissioned Officers and Men) on the 1st January in each year from 1890 to 1895.

	On 1st Jan. 1890.	On 1st Jan. 1891.	On 1st Jan. 1892.	On 1st Jan. 1893.	On 1st Jan. 1894.	On 1st Jan. 1895.
Total Effectives	201,848	202,116	203,163	209,283	210,863	213,555
Establishment	206,246	206,809	208,112	207,897	207,542	209,174
Supernumerary	—	—	—	1,386	3,321	4,381
Wanting to complete	4,398	4,693	4,949	—	—	—

INCREASE and DECREASE of the ARMY during the last five years.

	During 1890.	During 1891.	During 1892.	During 1893.	During 1894.	Total for 5 Years.
INCREASE.						
RECRUITS JOINED	31,407	36,003	41,659	35,195	33,698	177,962
Other causes	—	—	—	—	*290	*290
Total increase	31,407	36,003	41,659	35,195	33,988	178,252
WASTE (EXCLUSIVE OF TRANSFERS TO THE RESERVE):						
Deaths	1,738	1,795	1,859	1,730	1,792	8,914
Desertion (net loss)	2,569	2,924	3,018	2,726	2,125	13,362
Given up as deserters	75	63	79	76	76	369
Discharged: Purchase, and free by indulgence	3,260	3,378	3,390	2,896	2,753	15,677
Discharged: Invalids	3,321	3,048	2,795	2,873	3,152	15,189
Discharged: Completion of engagement	2,628	2,217	2,041	1,773	1,555	10,214
Discharged: Misconduct	1,831	1,850	2,238	2,358	1,963	10,240
Discharged: Other causes	678	807	1,194	1,044	1,057	4,780
	11,718	11,300	11,658	10,944	10,480	56,100
To Militia, Yeomanry, and Volunteers	662	735	713	683	644	3,437
Other causes	202	275	383	244	—	1,104
Total waste (exclusive of transfers to the Reserve)	16,964	17,092	17,710	16,403	15,117	83,286
WASTE (BY TRANSFER TO THE RESERVE):						
On completion of service	12,085	16,128	16,320	15,624	14,796	74,953
On conversion of service	2,042	1,676	1,430	1,466	1,330	7,944
Relegated (after irregularly re-enlisting)	72	90	140	168	103	573
	14,199	17,894	17,890	17,258	16,229	83,470
Re-transfers from the Reserve	24	30	61	46	50	211
Total waste (by transfer to the Reserve)	14,175	17,864	17,829	17,212	16,179	83,259
NET GAIN by RECRUITING: Without deducting transfers to the Reserve	14,443	18,911	23,949	18,792	18,871	94,966
NET GAIN by RECRUITING: Deducting transfers to the Reserve	268	1,047	6,120	1,580	2,692	11,707

* Men of the Army Pay Corps taken on strength.

APPENDIX E.

INCREASE and DECREASE of the Militia (exclusive of the Permanent Staff) during the last five years.

		1890.	1891.	1892.	1893.	1894.
Number enrolled on 1st January in each year		103,685	101,820	102,032	108,288	113,330
INCREASE	Recruits	35,634	39,783	48,774	45,771	33,205
	Re-enlisted	2,513	2,327	2,468	3,161	1,871
	Re-joined from desertion	925	1,034	1,257	1,489	1,280
	Other causes	—	—	—	—	—
	Total increase	39,072	43,144	52,499	50,421	36,456
DECREASE	Dead	448	443	367	335	472
	Discharged: On termination of engagement	4,382	4,145	3,319	3,109	3,374
	Discharged: As Invalids	3,867	3,211	4,193	3,471	3,207
	Discharged: Recruits rejected after attestation	—	—	—	631	537
	Discharged: On payment	9,348	9,462	8,645	7,952	8,595
	Discharged: As bad characters	710	645	742	801	726
	Discharged: Other causes	—	—	399	138	74
		18,307	17,463	17,298	16,102	16,513
	Deserted and absentees struck off	8,903	10,706	12,330	14,048	10,507
	Joined Regular Army	12,662	13,542	15,659	14,314	13,264
	Joined Royal Navy and Marines	445	395	407	485	523
	Other causes	172	383	182	95	115
	Total decrease	40,937	42,932	46,243	45,379	41,394
	Net increase	—	212	6,256	5,042	—
	Net decrease	1,865	—	—	—	4,938
Number enrolled on 31st December in each year		101,820	102,032	108,288	113,330	108,392

INCREASE and DECREASE of the Militia Reserve during the year 1894, by Countries and Arms of the Service.

	Countries.			Total.	Arms.				Total.
	English Regiments.	Scotch Regiments.	Irish Regiments.		Artillery.	Engineers.	Infantry.	Medical Staff Corps.	
Number enrolled on 1st Jan. 1894	19,494	3,617	6,992	30,103	5,102	397	24,561	43	30,103
Enlisted	3,656	606	1,026	5,288	863	46	4,365	14	5,288
Re-enlisted	—	—	1	1	—	—	1	—	1
Other causes	—	—	—	—	18	—	—	7	25
Total increase	3,656	606	1,027	5,289	881	46	4,366	21	5,314
Dead	74	11	26	111	22	3	86	—	111
Discharged	2,395	428	668	3,491	590	38	2,855	8	3,491
Deserted and Absentees struck off	518	126	224	868	161	7	698	2	868
To Regular Army	279	50	118	447	48	2	396	1	447
To Royal Navy and Royal Marines	11	1	1	13	3	—	10	—	13
Other causes	134	15	54	203	—	4	224	—	228
Total decrease	3,411	631	1,091	5,133	824	54	4,269	11	5,158
Net increase	245	—	—	156	57	—	97	10	156
Net decrease	—	25	64	—	—	8	—	—	—
Number enrolled on 31st Dec. 1894	19,739	3,592	6,928	30,259	5,159	389	24,658	53	30,259

APPENDIX F.

Militia Recruits enlisted between the trainings of 1893 and 1894, specifying the casualties between date of enlistment and the annual training for 1894, and the numbers present at the annual training of 1894.

Arms.	Number enlisted between termination of the training of 1893 and termination of the training of 1894.		Casualties prior to commencement of preliminary drill or drill on enlistment.			Number finally approved and who came up for:—		Casualties during preliminary drill or drill on enlistment.						Number who completed preliminary drill or drill on enlistment, or who at the commencement of the training were still undergoing drill.	Casualties between preliminary drill or drill on enlistment and the annual training.							Absent from training, of 1894.			Present at training, of 1894.		
								Joined Regular Army or Royal Marines.							Joined Regular Army or Royal Marines.												
	Who elected to drill on enlistment.	Who elected to attend preliminary drill before training.	Rejected on final approval.	Absent from recruits' drill.	Other causes.	Drill on enlistment.	Preliminary drill.	During drill on enlistment.	During preliminary drill.	Discharged by purchase.	Discharged as permanently unfit.	Sent home as temporarily unfit.	Absented themselves without leave.	Other casualties.		Recruits drilled on enlistment.	Recruits who attended preliminary drill.	Dead.	Discharged by purchase.	Discharged for other causes.	Transferred to other militia battalions or corps.	Other casualties.	With leave.	Without leave.	Still undergoing recruits' drill.	Fit for service.	Permanently unfit.	Temporarily unfit.
Artillery	1,545	1,921	160	159	35	1,417	1,695	120	37	62	94	9	65	41	2,684	177	—	2	71	11	4	7	28	200	137	2,035	6	6
Engineers	280	194	44	11	2	250	167	1	—	2	15	5	1	2	391	4	—	—	3	—	—	—	—	1	2	378	1	2
Infantry	27,056	6,324	1,148	446	293	25,857	5,636	3,648	169	1,178	420	95	381	181	25,421	2,873	16	26	1,357	105	69	36	793	3,080	3,419	13,374	90	183
Medical Staff Corps	511	—	2	8	—	501	—	299	—	45	10	1	48	7	91	—	—	—	—	—	—	—	—	—	—	90	—	1
All Arms	29,392	8,439	1,354	624	330	28,025	7,498	4,068	206	1,287	539	110	495	231	28,587	3,054	16	28	1,431	116	73	43	821	3,281	3,558	15,877	97	192
	37,831		2,308			35,523		6,936								4,761							7,660			16,166		

APPENDIX G.

STRENGTH of the REGULAR ARMY, the MILITIA, VOLUNTEERS, and 1st and 2nd CLASS ARMY RESERVE, on the 1st January 1895, compared with the previous 10 years.

YEAR.	Regular Army (Non-commissioned Officers and Men).	1st Class Army Reserve.	* Total Regular Army and 1st Class Army Reserve.	Militia (Non-commissioned Officers and Men).	Yeomanry (Non-commissioned Officers and Men).	Volunteers (Number Enrolled).	Total Militia and Volunteers.	General Total, including the Regular Army, 1st Class Army Reserve, Militia, and Volunteers.	† 2nd Class Army Reserve (not included in foregoing Columns).	
					At date of Inspection in previous year.	1st November, previous year.			Reserves of 1859 and 1867.	Enrolled Pensioners.
1885 - - -	181,008	39,244	220,252	104,380	10,801	215,015	330,196	550,448	1,225	6,513
1886 - - -	192,929	41,963	234,892	108,196	10,640	224,012	342,848	577,740	1,070	5,753
1887 - - -	200,507	46,858	247,365	110,488	10,554	226,752	347,794	595,159	789	4,906
1888 - - -	203,060	50,950	254,010	108,718	10,312	228,038	347,068	601,078	492	3,626
1889 - - -	202,761	50,341	253,102	106,533	10,017	226,469	343,019	596,121	369	2,485
1890 - - -	201,848	54,136	255,984	103,685	9,774	224,019	337,478	593,462	295	1,651
1891 - - -	202,116	59,280	261,396	101,820	9,752	221,048	332,620	594,016	161	792
1892 - - -	203,163	68,421	271,584	102,032	9,776	222,046	333,854	605,438	122	390
1893 - -	209,283	76,595	285,878	108,288	9,637	225,423	343,348	629,226	86	193
1894 - - -	210,863	80,349	291,212	113,330	9,530	227,768	350,628	641,840	57	124
1895 - - -	213,555	82,804	296,359	108,392	9,227	231,368	348,987	645,346	46	97

* The Militia Reserve is not included in this column.

† The 2nd Class Army Reserve and the Enrolled Pensioners are gradually dying out.

THIRTY-THIRD REPORT

OF

THE ROYAL COMMISSIONERS

OF THE

PATRIOTIC FUND

TO

Her Majesty the Queen.

Being the Twenty-Sixth Report of the Commissioners appointed by the Supplementary Commission, dated the 26th March, 1868.

Presented to both Houses of Parliament by Command of Her Majesty.

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Colonel J. S. YOUNG, *Secretary to the Royal Commission, and the Executive and Finance Committee.*

53, Charing Cross, S.W.

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THIRTY-THIRD REPORT

OF THE

ROYAL COMMISSIONERS

OF THE

PATRIOTIC FUND.

9TH APRIL, 1895.

1. We, your Majesty's Commissioners for the administration of the Patriotic Fund (appointed under the Supplementary Commission, dated 26th March, 1868), humbly submit to Your Majesty our Thirty-third Report.

2. The Funds administered by the Commission, with the several amounts standing to the credit of the capital account of each Fund, on the 31st of December, 1894, were as follows:—

	£	s.	d.
Patriotic Fund	342,910	17	2
Rodriguez Fund	14,771	6	8
"Captain" Relief Fund	32,064	3	0
"Eurydice" ,,	14,186	6	9
Royal Naval ,,	7,725	2	7
Zulu War Fund	25,404	2	8
"Atalanta" Relief Fund	7,400	0	0
"Soldiers' Effects" Fund	125,607	10	6
Ashantee War Fund	2,000	0	0
Zervudachi Fund	1,783	7	11
Light Brigade (Balaclava) Relief Fund	2,700	0	0
County of Forfar Fund	829	12	0
"Victoria" Relief Fund	66,614	12	10
Royal Victoria Patriotic Asylum Endowment Fund	157,766	13	5
,, ,, ,, Thurlow Fund	591	11	2
Roman Catholic Orphans' Fund	35,504	3	6
Total of Funds administered	£837,859	10	2

The following capital sums were allocated out of the Patriotic Fund in former years to secure nominations in perpetuity as under:—

1. For maintenance and education of five orphan daughters of Naval and Marine Officers in the Royal School for Naval and Marine Officers' Daughters	5,000	0	0
2. For maintenance and education of seven orphan sons of Naval and Marine Officers in the Royal Naval School	8,000	0	0
3. For maintenance and education of eighteen orphan sons of Military and Marine Officers in Wellington College	25,000	0	0
4. For education and partial maintenance of orphan children of Sailors, Soldiers, and Marines below the rank of Officer:—			
11 in Royal Seamen and Marines' Orphan Schools, Portsmouth	2,500	0	0
13 in Royal Naval and Military Free School, Devonport	2,500	0	0
Grand totals	£880,859	10	2

3. A tabular Statement of the Stocks in which the above Funds are invested will be found in Appendix I. (pages 12 and 13). The Capital and Income Accounts of each Fund for the year 1894 are also appended (Appendices V. to XX., pages 26 to 53); and the Report thereon of Mr. G. H. Tripp, the Auditor appointed by the Lords Commissioners of Your Majesty's Treasury to audit the accounts of this Commission, will be found in Appendix II. (pages 14 to 16).

Numbers of Widows, Orphans, and Others in Receipt of Benefits.

4. There were in receipt, on the 31st December, 1894, of benefits from the various Funds administered by the Commission the following :—

NAME OF FUND.	Officers.						Non-Commissioned and Petty Officers, Soldiers, Sailors and Marines.						
				Children.						Children.			
	Widows.	Widows re-married (half-allowance).	Other Dependents	Ordinary Allowance.	Special Infirm Allowance.	Education and Maintenance.	Widows.	Widows re-married (half allowance).	Other Dependents.	Ordinary Allowance.	Special Infirm Allowance.	In Orphanages.	Education and Partial Maintenance.
Patriotic Fund	59	7	...	2	6	...	891	429	...	...	10	...	...
Do. Royal Victoria Patriotic Asylum	...	...	...	...	...	...	...	...	...	...	...	286	...
Do. Roman Catholic Orphans' Fund	...	...	...	...	...	...	...	...	...	...	...	71	...
Do. Nominations to:													
Royal Cambridge Asylum	...	...	...	...	...	...	3	...	...	...	...	...	...
Wellington College ...	...	...	...	...	...	18	...	...	...	...	...	...	...
Royal Naval School ...	...	...	...	...	...	7	...	...	...	...	...	...	...
Royal School for Naval and Marine Officers' Daughters	...	...	...	...	...	5	...	...	...	...	...	...	...
Royal Seamen and Marines' Orphan School, Portsmouth ...	...	...	...	...	...	...	...	...	...	...	...	...	6
Royal Naval and Military Free Schools, Devonport	...	...	...	...	...	...	...	...	...	...	...	...	4
Rodriguez Fund	1	...	2	...	...	5	...	...	...	...	...	...	...
"Captain" Relief Fund ...	...	...	...	...	...	...	41	43	4	...	...	...	...
"Eurydice" Relief Fund ...	3	1	...	2	...	...	17	15	...	...	...	...	...
Royal Naval Relief Fund ...	...	...	1	...	...	...	2	...	3	...	...	...	...
Zulu War Fund	8	...	...	9	...	...	25	...	...	...	...	...	...
"Atalanta" Relief Fund ...	5	...	...	6	...	...	10	...	...	3	...	...	...
"Soldiers' Effects" Fund ...	...	...	...	...	...	...	62	...	...	102	...	...	...
Ashantee War Fund	...	...	...	...	...	...	8	...	...	...	...	...	...
Light Brigade (Balaclava) Relief Fund	...	...	...	...	...	...	...	...	*17	...	...	...	...
County of Forfar Fund ...	...	...	...	...	...	...	2	...	...	...	...	...	...
"Victoria" Relief Fund ...	6	...	7	10	...	...	79	...	219	126	...	...	...
Total ...	82	8	10	29	6	35	1140	487	243	231	10	357	10

* Survivors of Charge of the Light Brigade at the Battle of Balaclava, 25th October, 1854.

Patriotic Fund.

Actuary's Estimate.

5. The Report of the Actuary, Mr. Finlaison, on the financial condition of the Patriotic Fund as at 31st December 1894, will be found in Appendix III. (page 17).

The main feature of that Report is an exhaustive explanation of the fact, that, notwithstanding the considerable increase made in 1894 to the allowances payable to the Widows of Petty and Non-commissioned Officers, Sailors and Soldiers (exclusive of the special old age allowances to Widows of 60 years of age and upwards), as referred to in paragraph 5 of last year's Report to Your Majesty, Mr. Finlaison is able to state the surplus of Assets over Liabilities as £74,136 at 31st December 1894, against £70,325 as at 31st December 1893.

We had, naturally, anticipated that the surplus at 31st December 1894 would have shewn a very considerable diminution on that at 31st December 1893, for the increase made in 1894 to the allowances to Widows, as referred to above, resulted in the liability for 891 Widows remaining on 31st December 1894 having to be taken by the Actuary at £15,411 a year as against £13,293 a year for 912 Widows on 31st December 1893.

With reference to this present large surplus of Assets, £74,136, we have ameliorated the conditions under which the special old age allowances to Widows of 60 years of age and upwards are issued, thus entailing additional expenditure of about £2,200 a year, and we have directed that the Widows of Officers shall receive the old age allowance on attaining 60 years of age instead of at 65 years of age as at present; also that the allowances to children of Officers and men which have been continued for life beyond the ordinary limits of age on account of infirmity, shall be augmented to meet their increased necessities, seeing that they are all now upwards of 35 years of age.

We are precluded by the terms of Section 5 Patriotic Fund Act, 1867, from placing on the Patriotic Fund any Widows but those who are able to produce acceptable evidence that their husbands' deaths were due directly to wounds or disease contracted in the War with Russia 1854-6.

If, however, Your Majesty's Advisers should advise Your Majesty to issue a Supplementary Commission whereby we should be authorized to apply the Patriotic Fund as contemplated by Section 4 Patriotic Fund Act of 1881, we would, in view of the existing large surplus of Assets, take steps to place on the Fund such further numbers of necessitous and deserving Widows of Sailors, Soldiers, and Marines as we may deem prudent from time to time.

VICTORIA RELIEF FUND.

6. In the Accounts which accompanied last year's Report, it was shewn that up to 31st December, 1893, £67,610 16*s.* 6*d.* had been received.

In 1894 further contributions were received amounting to £5,654 16*s.* 5*d.*, including balances of subscriptions raised at Portsmouth and Malta, £5,535 and £67 6*s.* 10*d.* respectively, bringing the total contributions to the Fund administered by this Commission up to £73,265 12*s.* 11*d.*

The total expenditure in relief from the Fund to Widows, Orphans and other dependents of Officers and men lost in H.M.S. "Victoria" from the date of the first issue in November 1893 up to 31st December 1894, was £4,631 5*s.* 7*d.*

The cost to the Fund of this distribution was as follows:—

Charge for cost of management, including all office services, audit of accounts, printing, postage and stationery, calculated at 4 per cent. on income arising from dividends on invested Capital, viz., £2,111 19*s.* 7*d.*	£84	10	0
Cost of Post Office orders, and Power of Attorney	13	15	11
Actuary's fee	15	15	0
Total	£114	0	11

In relation to the total expenditure in relief as stated above, £4,631, the gross cost was thus £2 9*s.* 3*d.* per cent, while if the Actuary's fee be excluded, £2 2s. 5d. per cent. was the cost, and if the office charges £84 10*s.* be taken alone, the cost was only £1 16*s.* 6*d.* per cent. on the expenditure.

This statement of the cost of management of the Victoria Relief Fund will, it is hoped, remove any fears which may have been entertained by subscribers to the Fund as to the cost of its administration under the Patriotic Fund Commission.

The charges detailed above are exactly the same as have been made to other similar Funds which have been under the administration of the Patriotic Fund Commission for many years, always provided that the financial condition of such Funds after provision for their special objects admitted of a charge for cost of management.

The Actuary's Report on the financial condition of the Fund will be found in Appendix IV. (page 23), and shews that the surplus of assets over liabilities, which stood at £6,282 18*s.* 4*d.* at 31st December 1893, as referred to in last year's Report to Your Majesty, has been reduced by liabilities incurred in connection with claims received and admitted in 1894 to £1,941 at 31st December 1894.

Royal Victoria Patriotic Asylum.

7. The average number of Orphans maintained in 1894 was 290, at a cost of £19 14*s.* 8*d.* for each Orphan, exclusive of charges for maintenance of buildings and grounds.

Health.

8 The Report of Dr. Dodson, the Medical Officer of the Asylum, is as follows for the year 1894:—

"During the year 1894 the general health of the children of the Patriotic School has been quite up to the usual high standard.

"By careful restriction of visiting when necessary, infectious disease has been kept outside the gates in spite of the extreme amount prevalent in London generally.

"The physical condition and appearance of the girls testifies to the sufficiency and efficiency of the dietetic and sanitary arrangements.

Religious Instruction.

9 The Diocesan Inspector's Annual Report is as follows:—

"It was inevitable that the changes of Staff should leave their mark on the work, especially as Miss Jackson has only been in charge a few weeks. The deterioration is, however, much less than might have been imagined, and is confined to the upper division, while the two lower divisions more than maintain their high standard. The children too appear brighter than in the past.

"The lower division need to revise the Church Lessons, but this is the only weakness, and the other subjects had been extremely well taught in a pointed and practical manner. There was, moreover, an intelligent general knowledge outside the actual lines of the syllabus.

"The middle division has again been well taught, especially in the Prayer Book and Church Catechism. Practice is needed in the individual repetition of the latter, but otherwise the results were considerably above the average. As last year, the written work of this division deserves special mention.

"Upper division.—Under the circumstances it was wise to substitute the outline of Morning Prayer for the Prayer Book subject specified in the syllabus, and this was intelligently known, as was also the explanation of the Catechism. The falling off was in the Biblical subjects, where there was less pointed and practical application than last year. The Managers might well consider whether some of these elder girls should not be presented for the Diocesan Prize Scheme."

Secular Instruction.

10 Your Majesty's Education Department Inspector's Annual Report is as follows:—

"The elementary work is good in the first, second, third, and fourth standards, but the Arithmetic is weak in the sixth standard, and very weak in the fifth standard. Reading and Composition in the fifth standard also need improvement. Singing by ear is very well done, and the Recitations are accurately and intelligently said. Needlework is very praiseworthy. Musical Drill is excellent. An additional Assistant Teacher would be of great advantage in this School."

11. We regret to have to record that two of the Commissioners have died since our last Report to Your Majesty, Lord Swansea on 28th November, 1894, and General Sir Edward Cooper Hodge on 10th December, 1894.

Sir Edward Hodge served on the Executive and Finance Committee for 16 years, and as a Member of the Committee of Management of the Royal Victoria Patriotic Asylum his kindly solicitude for the welfare of the Orphan Girls in that Institution was unceasing.

GEORGE, President.
EDWARD SAXE-WEIMAR.
NORFOLK.
NELSON.
MORLEY.
CLANWILLIAM.
CRANBROOK.
SIDMOUTH.
CHELMSFORD.

REVELSTOKE.
WANTAGE.
HERSCHELL.
WELBY.
E. F. LEVESON-GOWER.
EDWARD LUGARD.
HENRY DE WORMS.
JOSEPH RENALS, Lord Mayor.
WM. LIDDERDALE.
STUART KNILL.
GEORGE G. WELLESLEY.
FREDERICK STEPHENSON.
A. H. HOSKINS.
ANTHONY B. STRANSHAM.
W. M. DOWELL.
RALPH THOMPSON.
EVAN MACGREGOR.
GEORGE HAYTER CHUBB.
G. FITZGERALD.
RALPH H. KNOX.

J. S. YOUNG, Colonel,
Secretary.

9th April, 1895

APPENDIX

STATEMENT OF BALANCES ON STOCK ACCOUNTS IN H.M. PAYMASTER

TITLE OF STOCK.	General Account.	Don Rodriguez Fund.	"Captain" Relief Fund.	"Eurydice" Relief Fund.	Royal Naval Relief Fund	Zulu War Fund.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s
2¾ per cent. Consols	3,975 11 4	...	...	...	...	...
Belfast Corporation 3½ per cent Stock	...	...	...	3,000 0 0	5,000 0 0	...
Bristol Water Works 3½ per cent. Perpetual Debenture Stock, Acts 1882-8	5,000 0 0	12,500 0 0	...	...	...	...
Canada 4 per cent. Bonds, 1904	...	...	...	...	...	...
,, ,, (Reduced) Bonds, 1910 ...	17,600 0 0	...	...	...	...	...
,, ,, Inscribed Stock	...	...	11,915 0 0	...	...	...
Cape 4½ per cent. Bonds, redeemable by Annual Drawings of 1 per cent.	25,000 0 0	...	...	...	...	...
Ceylon 4 per cent. Inscribed Stock...	...	...	564 0 10	...	235 0 4	...
East Indian Railway 4 per cent. Deferred Annuity Cap., Guar. with Profits	54,105 0 0	...	...	...	...	...
East and West India Dock 4 per cent. Deb. Stock	...	...	...	...	...	..
Great Indian Peninsula Railway 4 p. c. Deb. Stock	8,800 0 0	...	...	...	...	..
Great Western Railway, 4 per cent. Debenture Stk.	69,504 0 0	...	...	...	...	...
India 3½ per cent. Stock	...	...	...	...	...	...
Leeds Corporation 4 per cent. Stock	...	...	...	...	...	...
Liverpool Corporation 3½ per cent. Stock	...	...	...	...	..	...
London and Brighton Railway, 4½ per cent. Perpetual Debenture Stock	15,000 0 0	...	...	...	...	...
London and Greenwich Railway, 4 per cent. Mortgage, 1908	...	...	...	...	...	...
London and St. Katherine Docks 4 p. c. Deb. Stock	...	...	...	...	...	...
Madras Railway 5 per cent. Stock	...	...	5,630 0 0	...	...	...
Manchester Ship Canal 4 p. c 1st Debentures, 1896	...	...	...	...	..	...
Manchester Ship Canal 4 p. c. 1st Debentures, 1914	...	...	...	...	...	...
Metropolitan Consolidated 3½ per cent. Stock ...	1,258 12 9	...	1,055 2 2	3,116 19 3	1,890 2 3	304 2
New South Wales 5 per cent. Bonds, 1890-8 ...	...	...	...	...	..	...
New South Wales 5 per cent. Bonds, 1889-1900 ...	...	...	6,700 0 0	...	...	...
New South Wales 4 per cent. Bonds, 1903 ...	...	...	...	...	...	...
New South Wales 3½ per cent. Inscribed Stock, 1918	6,000 0 0	...	3,300 0 0	...	...	...
New Zealand 3½ per cent. Inscribed Stock... ...	...	571 6 8	...	...	...	...
New Zealand 4 per cent. Inscribed Stock	...	...	...	...	...	...
North Eastern Railway 4 per cent. Debenture Stock	60,000 0 0	...	...	...	...	...
Portsmouth Corporation 3 per cent. Stock ...	...	...	...	...	...	...
Queensland 4 per cent. Inscribed Stock	13,297 13 1	...	...	8,069 7 6	...	...
South Australian 4 per cent. Bonds, 1899-1929 ...	27,300 0 0	1,700 0 0	2,900 0 0	...	600 0 0	14,300 0
Victoria 4 per cent. Bonds, 1899	...	...	...	...	...	...
Victoria 4½ per cent. Bonds, 1904	...	...	...	...	...	10,800 0
West Australian 4 per cent. Bonds, 1902	...	...	...	...	...	...
Wigan Corporation 3 per cent. Stock	...	...	...	...	...	...
	306,840 17 2	14,771 6 8	32,064 3 0	14,186 6 9	7,725 2 7	25,404 2

In addition to the above, there is held for the General Account, £1623 3*s.* 0*d.* in the East India Railway Annu
,, ,, "Victoria" Relief Fund £170 7*s* 6*d.* Mersey Docks and Harbour Boar
,, ,, Victoria Asylum £525 0*s.* 0*d.* ,, ,,
,, ,, "Soldiers' Effects" £210 0*s.* 0*d.* ,, ,,

Paymaster General's Office, Whitehall,

7th January, 1895.

I.

GENERAL'S BOOKS ON 31ST DECEMBER, 1894, ON ACCOUNT OF THE PATRIOTIC FUND.

...ta-ta" lief ind.	"Soldiers' Effects" Fund	Ashantee War Fund.	Zervudachi Fund.	Light Brigade (Balaclava) Relief Fund.	County of Forfar Fund.	"Victoria" Relief Fund.	Royal Victoria Asylum Endowment Fund.	Thurlow Fund.	Roman Catholic Orphans' Fund.	TOTALS.
£	£ s. d.	£	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
...	9,356 3 5	...	240 2 4	...	...	...	...	...	...	13,571 17 1
...	5,000 0 0	...	...	...	...	...	...	...	...	13,000 0 0
...	12,500 0 0	...	...	...	...	...	...	...	...	30,000 0 0
...	...	...	...	...	...	...	11,500 0 0	...	...	11,500 0 0
...	...	...	...	...	...	...	...	...	...	17,600 0 0
...	...	...	...	...	...	...	4,273 0 0	...	...	16,188 0 0
...	...	..	...	2,700 0 0	...	...	500 0 0	...	...	28,200 0 0
...	...	...	...	...	...	...	1,880 2 10	...	...	2,679 4 0
...	...	...	...	...	...	...	...	...	...	54,105 0 0
...	6,812 0 0	...	...	...	...	...	...	...	...	6,812 0 0
...	...	...	...	...	...	...	...	...	...	8,800 0 0
...	...	...	...	...	...	...	...	...	...	69,504 0 0
...	...	...	...	...	...	...	2,926 16 6	...	...	2,926 16 6
..	10,000 0 0	...	...	...	...	...	...	...	...	10,000 0 0
...	...	...	...	...	...	17,130 12 6	...	...	...	17,130 12 6
..	...	...	...	...	...	...	...	...	...	15,000 0 0
...	...	...	...	...	...	...	50,000 0 0	...	...	50,000 0 0
..	7,500 0 0	...	...	...	...	...	...	...	...	7,500 0 0
..	...	...	...	...	...	...	...	...	...	5,630 0 0
..	4,170 8 0	...	...	...	829 12 0	...	...	..	...	5,000 0 0
..	5,000 0 0	...	...	...	...	13,500 0 0	1,000 0 0	...	...	19,500 0 0
..	1,802 5 10	...	...	...	...	...	1,588 12 9	591 11 2	...	11,607 8 10
..	...	...	...	...	...	...	3,800 0 0	...	...	3,800 0 0
..	...	...	...	...	...	...	...	...	...	6,700 0 0
..	...	800	...	...	...	...	...	...	...	800 0 0
..	...	...	...	...	...	...	20,700 0 0	...	...	30,000 0 0
..	1,007 11 10	...	1,543 5 7	...	...	...	...	...	...	3,122 4 1
..	26,698 10 0	...	...	...	...	...	...	...	...	26,698 10 0
..	...	...	...	...	...	...	...	...	...	60,000 0 0
..	960 11 5	...	...	...	...	13,903 5 9	...	...	...	14,863 17 2
..	5,000 0 0	...	...	...	...	2,230 14 7	5,898 1 4	...	35,504 3 6	70,000 0 0
100	14,400 0 0	400	...	...	...	...	28,500 0 0	...	...	97,500 0 0
..	...	800	...	...	...	...	...	...	...	800 0 0
...	...	...	...	...	...	...	10,200 0 0	...	...	21,000 0 0
..	9,400 0 0	...	...	...	...	...	...	...	...	9,400 0 0
..	...	...	...	...	...	15,150 0 0	...	...	...	15,150 0 0
100	119,607 10 6	2,000	1,783 7 11	2,700 0 0	829 12 0	61,914 12 10	142,766 13 5	591 11 2	35,504 3 6	776,089 10 2

...s C., to February, 1953, less one-eighth (£202 17*s.* 10*d.*) surrendered towards a Sinking Fund.
...per cent. Annuity.
...per cent. ,,
...per cent. ,,

(*Signed*) C. S. MAUDE,

For the Paymaster General.

APPENDIX II.

Report of the Auditor appointed by the Treasury in pursuance of Section 17 of the Patriotic Fund Act, 1867 (30 & 31 Vict. c. 98), upon the Accounts of the Royal Commissioners of the Patriotic Fund for the year 1894.

1. The Accounts of the several Funds administered by the Royal Commissioners of the Patriotic Fund during the year 1894 have been examined by me with the relative Vouchers and Authorities, and subject to the observations contained in this Report, are certified as correct. The balances of Stock and other Securities standing in the names of the Official Trustees on the 31st December, 1894, have been verified by the Bank of England, with two exceptions,* viz., the balance of Ceylon Government Stock, which has been verified by the Crown Agents for the Colonies, and the balance of Portsmouth Corporation Stock, which has been verified by the National Provincial Bank of England.

Sale of Stock.

2. During the month of August, 1894, the sum of £71,905 4*s.* 9*d.* was realised by the sale of Stock belonging to the following Funds, viz., Patriotic, "Captain," "Eurydice," Royal Naval Relief, "Soldiers' Effects," County of Forfar, Royal Victoria Patriotic Asylum, and Thurlow Funds. The Stock having been sold with a view to re-investment, the proceeds were not placed to the credit of the Paymaster-General's Cash Account, but were retained by or on behalf of the Bank of England, in order that re-investments might be readily effected therefrom as opportunity offered. The sum of

* As regards the interpretation of Section 12 of the Patriotic Fund Act, 1867,—which requires that all Securities belonging to the Patriotic Fund, and not standing in the books of the Bank of England, shall be deposited in that Bank,—see the opinion of the Solicitor to the Treasury quoted in the Auditor's Report, dated 9th March, 1892.

£21,395 5*s.* 6*d.* was re-invested during the month of August, but the balance of the amount available was not required for re-investment until various dates ranging from the 26th September to the 6th November.

It appears to me that, in accordance with the provisions of Section 13 of the Patriotic Fund Act, 1867, the proceeds of the sales should have been carried at once to the Cash Account of the Paymaster-General in the books of the Bank of England, and that the necessary issues should have been made from that Account, from time to time, as the various purchases of Stock were effected.

Patriotic Fund.

3. The question raised in paragraph 4 of my Report for the year 1893 in connection with the grant of an allowance in Case No. 3236 has been referred to the Solicitor to the Treasury, whose reply will, I understand, be laid before the Commissioners at their next Meeting. The widow to whom the allowance was granted, died on the 1st July, 1894.

4. The covering authority of the Commissioners is required for the increase from 3*s.* 6*d.* to 7*s.* a week, with effect from the 1st October, 1894, of the allowances payable from this Fund to six Orphans, who are afflicted with permanent infirmities. (Cases Nos. 388, 1477, 2766, 2987, 3059, and N 682).

"Captain" Fund.

5. The investment of money belonging to this Fund in Metropolitan Consolidated Stock does not appear to be authorised by the terms of the Trust Deed under which the Fund is administered.

"Eurydice" Fund.

6. A similar remark applies to the investment made on account of this Fund in Belfast Corporation Stock.

Zulu War Fund.

7. The Commissioners have sanctioned the allowances mentioned in paragraph 6 of my Report for 1893.

Light Brigade (Balaclava) Relief Fund.

8. The overpayment of £3 6*s.* 6*d.* referred to in paragraph 8 of my Report for 1893, has been recovered.

Victoria Relief Fund.

9. The covering authority of the Commissioners is required for the following payments :—

(*a*) Sick allowance of 1*s.* 6*d.* a week in Case No. 8.

(*b*) Increase from 1*s.* to 3*s.* a week of the allowance in respect of each of two children, from the 31st July, 1894,—the date of their Mother's death. (Case No. 33).

(Signed) GEORGE H. TRIPP.

HOME OFFICE,
WHITEHALL,
12*th February*, 1895.

Note.—The objections raised in paragraphs 5 and 6 of above Report have been acted upon by the substitution, with effect from 1st January, 1895, of Securities authorised by the terms of the Trust Deeds of the "Captain" and "Eurydice" Funds and of equivalent value, for the Metropolitan Consolidated Stock and Belfast Corporation Stock held respectively by these Funds on 31st December, 1894.

J. S. YOUNG, Colonel,
27*th March*, 1895. *Secretary.*

APPENDIX III.

19, Old Jewry,

27th February, 1895.

Sir,

I forward herewith the results of the annual valuation of the assets and liabilities of the Patriotic Fund, as they are reported to have stood on the 31st December, 1894, in the accounts and schedules which accompanied your letter of the 17th January last.

The rates of pension payable to the Widows of Non-commissioned and Petty Officers, Soldiers and Seamen, have been considerably increased in the course of the year 1894, under the sanction of the Royal Commissioners, with the result that, exclusive of the old age allowances commencing at the age of 60 years, pensions amounting to about £15,411 a year were payable to 891 Widows at the 31st December, 1894, in comparison with £13,293 a year, payable to 912 Widows at the 31st December, 1893, this latter rate having also been increased from the scale in force at 31st December, 1892.

The average annual pension payable to the Widows, exclusive of the allowance of a little more than £5 4*s.* a year which commences at the age of 60 years, was £13 17*s.* a year at the 31st December, 1892, £14 11*s.* 6*d.* a year at the 31st December, 1893, and £17 6*s.* a year at the 31st December, 1894. These successive increases to the rates of pension have been possible, in the first place, in consequence of the regrettable fact that the number of deaths recorded to have taken place among the Widows during the years 1891, 1892, and 1893, were far above the numbers which would correspond to their stated ages, as well as above the rates observed to prevail among them in recent years. A more powerful cause has, however, been the large increase in the value of the securities that were so skilfully selected for the original investment of the Fund many years ago. The gain from this cause has hitherto been mainly shown in the shape of the relatively small diminution of the assets necessary to meet the calls for the periodical payment of the pensions, owing to the high prices realised for that part of the securities it has been necessary to sell, above their original cost.

These high market prices have now ruled for such a considerable duration of time as to lead to a conclusion that the period has arrived when the value placed upon the securities in the valuation balance sheet should follow in the direction of the estimation now established for the securities upon the market, although the extreme view has not been taken, that during the whole continuance of the lives of the present pensioners, they would realise prices corresponding to those now current.

Expression has accordingly been given in the valuation for the 31st December, 1894, to the opinion now held of the worth of the securities in the possession of the Fund and a considerable addition has been thus made to the credit side of the balance sheet.

Such an addition to the value of the assets, calls, however, for an addition to the value of the liabilities by discounting the future payments which will have to be made from the Fund at a lower rate of interest than that of 4 per cent. which was adopted many years ago and has been used until now in the annual investigations of the position of its affairs. It is only recently that such a change could properly have been made in the basis of the estimate of the extent of the engagements of the Fund, because, a few years ago, if a lower rate of interest than 4 per cent. had been used for discounting the liabilities, the market prices then current for securities would not have shown a corresponding increase in their value.

But the position of affairs has altered, the large number of deaths which have recently occurred among the pensioners by reducing the annual charge, and the increase in the ages of those who remain have, by shortening the probable duration of the annuities, diminished the effect of discount. These changes permit an alteration in the basis of valuation which could not formerly have been made. The pensions payable at the 31st December, 1894, and the contingent liabilities of the Fund have consequently been valued at a rate of interest of 2½ per cent. per annum.

The value of the Pensions to Widows amounting to £15,411 a year at 31st December, 1894, is placed at £143,750, in comparison with £117,700 for £13,293 a year, at 31st December, 1893, that is to say, an increase of £26,050 in the principal value of this class of pension has been shown in the account for the year 1894.

Two new allowances were granted in 1894, and 27 Widows, who had re-married, were transferred to the full rate, in consequence of the deaths of their second husbands. On the other hand, the deaths of 50 Widows were reported; thus showing a net decrease of 21 in the number on the full pay list, which stood at 891 at the end of the year.

The amount of pensions at the reduced rate to re-married women, at 31st December, 1894, was £2,945 a year, in comparison with £3,227 a year at 31st December, 1893, the reduction of charge being occasioned by 15 deaths among the pensioners and 27 deaths of husbands, while one pensioner was added to the list; these changes made the number of this class of pensioners 429 at the end of the year, or a reduction of 41 from the number on the list at the beginning of the year. The relative number of deaths among husbands and wives are the reverse of the occurrences of the year 1893, when 28 pensioners and 15 husbands of pensioners were reported to have died, so that the events of the two years considered together restore the balance of mortality between the sexes.

The liability for pensions at the reduced rate is placed at £30,700 for 31st December, 1894, in comparison with £31,675 at 31st December, 1893, the apparently small diminution of liability being due to the change in the basis of valuation already alluded to.

The number of deaths among Widows at the full rate was 49 in 1894, while one death which occurred in 1893 was reported in 1894, and as just stated, 15 re-married women were reported to have died in 1894; 64 deaths in all among these two classes of pensioners were therefore made known in 1894 in comparison with the estimated number of 56 for the year. The rate of mortality among the pensioners was consequently higher than was expected. The estimated number of deaths in 1895, according to the ages of the pensioners, is 57 out of the 1,320 on the lists at the 31st December, 1894.

An amount of £1,650 is placed among the liabilities as a provision for the possible restoration of pensions in abeyance, £1,000 is estimated to provide for allowances in sickness and subscriptions to Hospitals, and £1,850 for Funeral allowances.

The extra allowances for old age, to 430 Widows, amounting to £2,244 a year, are computed to entail a liability of £19,300, in comparison with

£15,900 for £1,983 a year at 31st December, 1893; 100 women were granted the allowance in the year, but death removed 50, so the increase in the number in receipt of this extra allowance was 50. £31,450 is reserved as a provision for further grants of extra allowance at the ages of 60 and 70 years, provision being made for all those Widows not actually in receipt of the allowance in this amount.

The provision for restoration to full allowances of the 429 re-married women, if they should survive their present husbands, is placed this year at £18,500, that is to say, an increase of £4,250 above the provision made under the corresponding head for 31st December, 1893, the addition being principally due to the increase made in 1894 to the full pension rate, while the rates to re-married women were unchanged.

The provision for old age allowances at 60 and 70 years of age to the re-married women, in case they should again become Widows, is, comparatively speaking, unchanged in amount, being diminished to £14,700 from £15,140, in relation principally to the decrease in the number of this class of pensioners, the rates of these allowances being the same for 31st December, 1894, as they were for 31st December, 1893.

The amount of the estimated liability for three Widows in the Cambridge Asylum has been retained at £1000.

Pensions at the full rate amounting to £2,066 a year were payable to 59 Officers' Widows at the 31st December, 1894, and are valued at £17,350 in comparison with £18,100 on account of £2,218 a year to 63 Widows at 31st December, 1893.

Seven re-married ladies remained on the half-pension list from last year, and £112 a year payable to them is valued at £1,225. Funeral allowances are estimated to entail a liability of £780, and £134 a year payable to 15 aged Widows, a liability of £875. A provision of £525 is made for the possible restoration to full pension of the seven re-married ladies, and £3,325 is estimated as the liability on account of deferred and contingent allowances.

The liability for payments on account of Orphans is estimated at £4,200, the principal part of this charge being on account of cases of prolonged infirmity.

Management and pensions are calculated to entail a liability of £23,850, *i.e.* very nearly the same amount as last year when the estimate was £23,900.

The usual reserve of £6,000 for unforeseen contingencies is also placed among the liabilities.

The total amount of the liabilities at 31st December, 1894, inclusive of £4,080 due to the general cash balance and the Bank of England, is placed at £326,110, in comparison with an estimated liability of £290,543 at 31st December, 1893, the increase of £35,567 in the year being attributable to the increases made to the allowances and to the lower rate of discount at which the future charge on the Fund has been brought to a present value.

The securities held by the Fund, have been this year, as has been already stated, valued with reference to higher prices than was the case last year but with a careful reference to the prices to be realised from time to time as their sale will be required to meet the periodical charges. A considerable part of the large gain which has accrued to the Fund from the very skilful way in which it was originally invested has thus been shown on the balance sheet for this year.

The total value of the assets at 31st December, 1894, is placed at £400,246, while, as just stated, the liabilities at the same date have been estimated at £326,110, a surplus balance of £74,136 is thus shown, that is to say, £3,811 above the corresponding balance for 31st December, 1893, when the securities were valued with reference to lower prices, the allowances were at lower rates, and the value of the future charge was estimated at a lower scale in relation to the prices then retained from former years for the valuation of the securities.

I am, Sir,

Yours faithfully,

(Signed) ALEX. J. FINLAISON.

Colonel J. S. YOUNG

Secretary to the

Royal Commission of the Patriotic Fund.

APPENDIX III.—*continued.*

PATRIOTIC FUND.—31st December, 1894.

LIABILITIES.

	£
£15,411 a year Allowance to 891 Widows	143,750
£2,945 a year Allowance to 429 re-married Women	30,700
Provision for restoration of Pensions in abeyance	1,650
Allowances in Sickness, and Subscriptions to Hospitals	1,000
Funeral Allowances	1,850
£2,244 a year Extra Allowances in course of Payment to 430 aged Widows	19,300
Provision for Deferred Extra Allowances including addition at 70 years of age	31,450
Provision for restoration to Full Allowances of 429 re-married women	18,500
Provision for Deferred Extra Allowances to 429 re-married women, including addition at 70 years	14,700
Payment to Cambridge Asylum on account of 3 Widows	1,000
£2,066 a year Full Pensions to 59 Officers' Widows	17,350
£112 a year Half Pensions to 7 re-married Widows	1,225
Funeral Allowances	780
£134 a year Extra Allowances in course of payment to 15 aged Widows	875
Provision for restoration to Full Pension rate of 7 re-married Widows	525
Provision for deferred and contingent Extra Allowances	3,325
Allowances to Orphans including Provision for Outfits	4,200
Office Establishment, Stationery, Postage, &c.	18,000
Pensions	4,900
Commission on Post Office Orders	950
Reserve for Contingencies	6,000
Due to Bank of England	3,863
Due to General Account	217
Surplus Balance	74,136
	£400,246

ASSETS.

				£	£
Great Indian Peninsula Railway Debenture Stock	4 per cent.	£8,800		at 125	11,000
Canada Bonds (1910)	4 ,,	17,600		,, 100	17,600
North-Eastern Railway Debenture Stock	4 ,,	60,000		,, 125	75,000
London and Brighton Railway Debenture Stock	4½ ,,	15,000		,, 140	21,000
Great Western Railway Debenture Stock	4 ,,	69,504		,, 125	86,880
Queensland Inscribed Stock (1915-1924)	4 ,,	13,297	13*s.* 1*d.*	,, 100	13,297
South Australian Bonds (1907-1929)	4 ,,	27,300		,, 100	27,300
Cape of Good Hope Bonds (1897-1900)	4½ ,,	25,000		,, 100	25,000
New South Wales Inscribed Stock (1918)	3½ ,,	6,000		,, 95	5,700
Consols	2¾ ,,	3,975	11*s.* 4*d.*	,, 98	3,896
Bristol Water Works Perpetual Debenture Stock	3½ ,,	5,000		,, 100	5,000
Metropolitan Consolidated Stock	3½ ,,	1,258	12*s.* 9*d.*	,, 110	1,385
East India Railway Annuity, Class C, £1,623 3*s.* a year, with Sinking Fund					36,070
East India Railway Deferred Annuity, Class D, with Profits and Sinking Fund		54,105		at 120	64,926
Dividends accrued at 31st December, 1894			£6,180		
Cash in Office			12		
					6,19
					£400,246

(*Signed*) ALEX J. FINLAISON,
27th February, 1895.

APPENDIX IV.

19, Old Jewry, E.C.,

6th March, 1895.

Sir,

In accordance with the request in your letter of the 23rd January last, I have made a valuation of the assets and liabilities of the "Victoria" Relief Fund, as they are reported to have stood on the 31st December, 1894.

The list of the pensions payable from the Fund commences with £240 a year to 6 Widows of Officers, estimated to entail a charge equivalent to a principal value of £4,225 Seven Officers' relatives have been granted pensions of £121 12*s*. a year of the estimated value of £2,110. A more considerable head of charge upon the Fund consists of pensions, amounting to £1,763 a year, payable to 79 Widows of Non-commissioned and Petty Officers, Sailors and Marines, which are computed to bring a liability of £39,300 on the Fund.

Allowances amounting to £87 8*s*. a year to 9 Male relatives of Sailors and Marines are valued at £1,015; to 38 Female relatives, amounting to £426 11*s*. 6*d*. a year at £5,470; and £456 11*s*. 6*d*. a year payable to 39 couples jointly, with benefit of survivorship, at £7,025. In 37 cases £226 12*s* a year is payable for short fixed terms and is estimated to be equivalent to £640 of capital. Funeral allowances are valued at £250 and allowances which may be granted in sickness at a similiar amount.

Temporary allowances granted to 10 Orphans of Officers, amounting to £128 a year, are estimated to be worth £840, while allowances of £350 18*s*. a year to 126 Orphans of Sailors and Marines are valued at £2,875, and £120 a year to 15 dependent children at £940. The outfits which may be granted to 136 of the Orphans are estimated to be of the value of £3,155.

The expenses of management are estimated to represent £2,000 of capital.

The whole of the liabilities recapitulated above amount to £70,095, in comparison with a computed liability of £66,900 shown in the valuation balance sheet of the Fund annexed to my letter of the 22nd February, 1894; the increase of £3,195 being mainly attributable to additional pensions granted to relatives of the Sailors and Marines lost in the ship.

The assets of the Fund, inclusive of £1,050 on account of dividends accrued at 31st December, 1894, are estimated to be worth £72,036. A surplus balance of £1,941 of assets is consequently estimated to exist over and above the liabilities of £70,095 at 31st December, 1894. The pensions to Widows have, however, been in all cases valued upon the assumption that they would continue payable at the full amount during the duration of their lives, but it is probable, in accordance with the experience of other Funds under the management of the Royal Commission, that a proportion of the Widows will re-marry, when, according to the regulation communicated to me, they will be entitled to half pensions only.

I am, Sir,

Yours faithfully,

(Signed) ALEX. J. FINLAISON.

Colonel J. S. YOUNG,
Secretary to the
Royal Commission of the Patriotic Fund

APPENDIX IV.—*continued.*

"VICTORIA" RELIEF FUND. 31st December, 1894.

LIABILITIES.

	£
£240 a year to 6 Officers' Widows	4,225
£121 12*s.* a year to 7 Officers' relatives	2,110
£1,763 a year to 79 Widows	39,300
£87 8*s.* a year to 9 Male relatives	1,015
£426 11*s.* 6*d.* a year to 38 Female relatives	5,470
£456 11*s.* 6*d.* a year to 78 relatives in groups of two lives with benefit of survivorship	7,025
£226 12*s.* a year for short terms, 37 cases	640
Funeral Allowances	250
Allowances in Sickness	250
£128 a year to 10 Orphans of Officers	840
£350 18*s.* a year to 126 Orphans	2,875
£120 a year to 15 dependent Children	940
Outfits for 136 Orphans	3,155
Expenses of Management	2,000
Surplus Balance	1,941
	£72,036

ASSETS.

				£	£
Liverpool Corporation Stock	3½ per cent.	£17,130 12*s.* 6*d.*	at 120		20,557
Manchester Ship Canal Debentures.	4 ,,	13,500	,, 102		13,770
Portsmouth Corporation Stock	3 ,,	13,903 5*s.* 9*d.*	,, 102		14,181
Wigan Corporation Stock	3 ,,	15,150	,, 102		15,453
Mersey Dock and Harbour Board Annuities	3⅛ ,,	4,700	,, 102		4,794
Queensland Inscribed Stock	4 ,,	2,230 14*s.* 7*d.*	,, 100		2,231
Accrued Dividends					1,050
					£72,036

(*Signed*) ALEX. J. FINLAISON.

6*th March*, 1895.

APPENDI
PATRIOTI
CAPITA

Dr.

RECEIPTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Wate Works, &c.	
			Home.	Indian and Colonial.	Home.	India and Coloni
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£	£ s.
To Balance of Securities on 1st January, 1894, viz.—						
Consols, 2¾ per cent.	...	...	4,032 15 0			
Canada 4 per cent. (Reduced) Bonds redeemable 1st January, 1910	17,600 0 0					
Cape of Good Hope 4½ per cent. Bonds redeemable by 15th October, 1897	26,500 0 0					
New South Wales 3½ per cent. Inscribed Stock (1918)	6,000 0 0					
Queensland 4 per cent. Inscribed Stock (1915)	13,405 17 10					
South Australian 4 per cent. Bonds (1907-29)	29,800 0 0					
„ „ Inscribed Stock (1917-36)	2,329 15 8					
				95,635 13 6		
Bristol Water Works 3½ per cent. perp. Deben. Stk.	5,000 0 0					
Great Western Railway 4 per cent. Debenture Stock	69,504 0 0					
London, Brighton and South Coast Railway 4½ per cent. Perpetual Debenture Stock	15,000 0 0					
North Eastern Railway 4 per cent. Debenture Stock	60,000 0 0					
					149,504	
Estimated Capital Value on 14th February, 1953, of Sinking Fund in the East India Railway Annuity, Class C	36,070 0 0					
East Indian Railway Deferred Annuity, Class D, per Act 55 Vict. Cap. X, part II—						
Capital estimated to be forthcoming on 14th February, 1953, from the Sinking Fund provided for holders thereof	54,105 0 0					
Great Indian Peninsula Railway 4 per cent. Debenture Stock	8,800 0 0					
						98,975 0
„ Cash, proceeds of Cape of Good Hope 4½ per cent. Bonds paid off 16th April.		1,500 0 0				
„ Cash, proceeds of Sale of £2,329 15*s.* 8*d.* South Australian 4 per cent. Inscribed Stock as per contra		2,466 12 2				
„ Securities purchased on 6th November, viz.:— Metropolitan Consolidated 3½ per cent. Stock, 1929		...	2,099 4 0			
„ Cash transferred from Capital Account of—						
Rodriguez Fund	For Securities transferred by this Fund as per contra.	415 0 0				
"Captain" Relief Fund		264 11 2				
"Eurydice Relief" „		98 2 10				
Royal Naval Relief „		279 13 6				
Zulu War „		364 4 0				
"Soldiers' Effects" „		2,178 15 0				
Zervudachi „		59 0 10				
Roman Catholic Orphans Fund		116 12 7				
Total £		7,742 12 1	6,131 19 0	95,635 13 6	149,504	98,975 0 0

ND.

COUNT, 1894. *Cr.*

PAYMENTS.	CASH.	Government and Municipal Securities. Home.	Government and Municipal Securities. Indian and Colonial.	Securities of Railways, Water Works, &c. Home.	Securities of Railways, Water Works, &c. Indian and Colonial
	£ s. d.	£ s. d.	£ s. d.	£	£ s. d.
ape of Good Hope 4½ per cent. Bonds paid off 16th April . .	...	...	1,500 0 0		
ale of South Australian 4 per cent. Inscribed Stock, 15th August, as per contra	...	...	2,329 15 8		
ash paid for £2,099 4s. Metropolitan Consolidated 3½ per cent. Stock, as per contra.	2,466 12 2	...			
ransfer of Cash to Capital Account "Eurydice" Relief Fund to correct error in transfer on 30th December, 1893, of £94 9s. 5d. Queensland 4 per cent. Inscribed Stock, instead of £94 17s. 5d.	0 8 2	...			
ecurities transferred on 31st December, 1894 :—					
To Rodriguez Fund—					
South Australian 4 per cent. Bonds, (1909) . . .	...	...	400 0 0		
,, "Captain" Relief Fund—					
Metropolitan Consolidated 3½ per cent. Stock, (1929)	...	220 18 6			
,, "Eurydice" Relief Fund—					
Metropolitan Consolidated 3½ per cent. Stock, (1929)	...	81 19 1			
,, Royal Naval Relief Fund—					
Metropolitan Consolidated 3½ per cent. Stock, (1929)	...	233 11 0			
,, Zulu War Fund—					
Metropolitan Consolidated 3½ per cent. Stock, (1929)	...	304 2 8			
,, "Soldiers' Effects" Fund—					
South Australian 4 per cent. Bonds, (1907-8) . .	...	...	2,100 0 0		
,, Zervudachi Fund—					
Consols 2¾ per Cent.	...	57 3 8			
,, Roman Catholic Orphans' Fund—					
Queensland 4 per cent. Inscribed Stock, (1915) . .	...	...	108 4 9		
ash transferred to General Fund (Income) Account during the year	5,275 11 9				
	7,742 12 1	897 14 11	6,438 0 5	...	...
alance of Securities on 31st Dec., 1894, viz.:—	£ s. d.				
onsols 2¾ per cent.	3,975 11 4				
etropolitan Consolidated 3½ per cent. Stock, (1929)	1,258 12 9	...			
anada 4 per cent. (Reduced) Bonds, redeemable 1st January, 1910	17,600 0 0	5,234 4 1			
ape of Good Hope 4½ per cent. Bonds, redeemable by 15th October, 1897	25,000 0 0				
ew South Wales 3½ per cent. Inscribed Stock, (1918)	6,000 0 0				
ueensland 4 per cent. Inscribed Stock (1915) .	13,297 13 1				
outh Australian 4 p. c. Bonds (1907-29) . .	27,300 0 0				
			89,197 13 1		
ristol Water Works 3½ p. c. Perp. Debenture Stock	5,000 0 0				
reat Western Railway 4 per cent. Debenture Stock	69,504 0 0				
ondon, Brighton, and South Coast Railway 4½ per cent. Perpetual Debenture Stock . . .	15,000 0 0				
orth-Eastern Railway 4 per cent. Debenture Stock	60,000 0 0				
				149,504	
stimated Capital Value on 14th February, 1953 of Sinking Fund in East Indian Railway Annuity, Class C	36,070 0 0				
ast Indian Railway Deferred Annuity, Class D, per Act 55 Vict. Cap. X, part II—					
Capital estimated to be forthcoming on 14th February, 1953, from the Sinking Fund provided for holders thereof	54,105 0 0				
reat Indian Peninsula Railway 4 per cent. Debenture Stock	8,800 0 0				98,975 0 0
Total . £	7,742 12 1	6,131 19 0	95,635 13 6	149,504	98,975 0 0

Subject to observations in Report—Examined and found correct,

igned) J. S. YOUNG, Colonel, *Secretary.*

(Signed) GEORGE H. TRIPP. *12th February, 1895.*

APPENDIX

PATRIOTIC

Dr. INCOME

RECEIPTS.				£	s.	d.
To Dividends received on the undermentioned Securities, viz :						
£4,032 15*s.* 0*d.* Consols, 2¾ per cent.				110	18	0
£17,600 0*s.* 0*d.* Canada 4 per cent. (Reduced) Bonds				682	0	0
£26,500 0*s.* 0*d.* Cape of Good Hope 4½ per cent. Bonds	April, £578 17 2					
£25,000 0*s.* 0*d.* ,, ,, ,, ,, ,,	Oct., 543 15 0			1,122	12	2
£6,000 0*s.* 0*d.* New South Wales 3½ per cent. Inscribed Stock				210	0	0
£13,405 17*s.* 10*d.* Queensland 4 per cent. Inscribed Stock				536	4	8
£29,800 0*s.* 0*d.* South Australian 4 per cent. Bonds				1,154	15	0
£2,329 15*s* 8*d.* ,, ,, Inscribed Stock			April	45	4	9
£5,000 0*s.* 0*d.* Bristol Water Works 3½ per cent. Perp. Debenture Stock				169	14	4
£69,504 0*s.* 0*d.* Great Western Railway 4 per cent. Debenture Stock				2,696	3	6
£15,000 0*s.* 0*d.* London Brighton and South Coast Railway 4½ per cent. Perpetual Debenture Stock				654	12	3
£60,000 0*s.* 0*d.* North Eastern Railway 4 per cent. Debenture Stock				2,327	10	0
£1,623 3*s.* 0*d.* per ann. E. Indian Ry. Annuity, Class C	£811 11 6					
Less—Income Tax	£23 13 5					
,, Management	3 7 8					
,, Sinking Fund at 2*s.* 6*d.* in the £, per Act 55 Vict. c. X.	101 8 11					
		128 10 0				
			April 683 1 6			
£1,623 3*s.* 0*d* per ann. E. Indian Ry. Annuity, Class C	£811 11 6					
Less—Income Tax	£27 1 0					
,, Management	3 7 8					
,, Sinking Fund at 2*s.* 6*d.* in the £ per Act, 55 Vic. c. X.	101 8 11					
		131 17 7				
			Oct. 679 13 11			
				1,362	15	5
£54,105 East India Railway 4 per cent. Deferred Annuity, Class D. January		£1,717 16 8				
Less—Income Tax	£50 2 1					
,, Sinking Fund at 11*s.* 3*d.* for every £4 of Interest under Sec. 6 of Act 55 Vict. cap. X.	152 3 5					
		202 5 6				
			Jan. 1,515 11 2			
£54,105 East India Railway 4 per cent. Deferred Annuity, Class D, July		£1,298 10 5				
Less—Income Tax	£43 5 8					
,, Sinking Fund at 11*s.* 3*d.* for every £4 of Interest under Sec. 6 of Act 55 Vict. cap. X.	152 3 5					
		195 9 1				
			July 1,103 1 4			
				2,618	12	6
£8,800 0*s.* 0*d.* Great Indian Peninsula Railway 4 per cent. Debenture Stock				341	0	0
						14,032 2 7
,, Income Tax repaid by Commissioners of Inland Revenue				...		418 7 5
,, Transfers from Special Funds towards Cost of Management, viz. :—						
"Captain" Relief Fund				54	10	0
"Eurydice" Relief Fund				23	0	0
Royal Naval Relief Fund				12	0	0
Zulu War Fund				42	0	0
"Atalanta" Relief Fund				12	0	0
"Soldiers' Effects" Fund				179	0	0
Ashantee War Fund				3	0	0
Light Brigade Relief Fund				5	0	0
County of Forfar Fund				1	0	0
"Victoria" Relief Fund				84	10	0
Royal Victoria Patriotic Asylum				262	0	0
						678 0 0
,, Cash transferred from General Fund Capital Account during the year				...		5,275 11 9
,, Loan from Bank of England 29th December				...		3,863 8 11
						24,267 5 8
,, Balance on 31st December, 1894		£217 12 8				
Less—Cash in Office		12 13 3				
						204 19 5
			Total		£	24,472 5 1

FUND.

ACCOUNT, 1894. *Cr.*

EXPENDITURE.	£ s. d.	£ s. d.
By Balance on 1st January, 1894	282 1 2	
Less—Cash in Office	9 11 11½	222 9 2½
,, Amount of Allowances to Widows and Orphans of other than Officers :—		
Army (including amount paid to Royal Cambridge Asylum for three Widows, £85 12*s.* 8*d.*)	14,256 5 6	
Navy	4,346 15 6	18,603 1 0
,, Amount of Allowances to Widows and Orphans of Officers	2,303 4 9	
,, ,, of Allowances to Orphans of Officers of other Wars than Russian	12 0 0	2,315 4 9
,, Subscriptions to Hospitals, &c.	...	20 0 0
,, Expenses of Management, viz.:—		
Salaries—Office	1,159 7 2	
Stationery, Books, and Printing	94 16 0	
Postage—Office	84 2 9½	
Travelling Expenses	8 14 5	
Fee for Auditing Accounts for 1894	50 0 0	
Fee for Preparation of Estimate of Assets and Liabilities	26 5 0	
Miscellaneous Office Expenses (Housekeeper, Fuel, Light, &c.)	162 18 8	1,580 18 7½
,, Commission on Post Office Orders		91 1 8
,, Allowances to Retired Officers of Office Staff		638 8 8
,, Interest on Loan £3,863 3*s.* 11*d.*, as per contra		1 1 2
,, Repayment of Loan to Bank of England, 3rd January		1,000 0 0
Total	£	24,472 5 1

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Subject to observations in Report—Examined and found correct,
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

RODRIGUEZ

Dr. CAPITAL

RECEIPTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£	£
To Balance of Securities on 1st January, 1894, viz. :—					
Bristol Water Works 3½ per cent. Perp. Deb. Stock	...	...	...	12,500	
New Zealand 3½ per cent. Inscribed Stock (1940) £571 6 8					
South Australian 4 per cent. Bonds (1908-9) 1,300 0 0					
			1,871 6 8		
,, Cash transferred from Income Account	415 0 0				
,, Securities transferred from General Fund, Capital Account, on 31st December, 1894, viz. :—					
South Australian 4 per cent. Bonds, (1909)	...	...	400 0 0		
Total £	415 0 0	...	2,271 6 8	12,500	...

Dr. INCOME

RECEIPTS.	£ s. d.	£ s. d.
To Balance on 1st January, 1894	...	42 7 6
To Dividends received on the undermentioned Securities, viz. :—		
£12,500 0*s.* 0*d.* Bristol Water Works 3½ per cent. Perp. Debenture Stock	424 5 9	
£571 6*s.* 8*d.* New Zealand 3½ per cent. Inscribed Stock	19 19 10	
£1,300 0*s.* 0*d.* South Australian 4 per cent. Bonds	50 7 6	
		494 13 1
,, Income Tax repaid by Commissioners of Inland Revenue		13 11 8
		550 12 3
To Balance on 31st December, 1894		20 13 3
Total £		571 5 6

VI.

FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
			Home.	Indian and Colonial.	Home.	Indian and Colonial.
		£ s. d.	£ s. d.	£ s. d.	£	£
By Cash transferred to General Fund, Capital Account, for £400 South Australian 4 per cent. Bonds as per contra		415 0 0				
		415 0 0				
By Balance of Securities on 31st December, 1894, viz.:—						
Bristol Water Works 3½ per cent. Perp. Deb. Stock		...	...	...	12,500	
New Zealand 3½ per cent. Inscribed Stock (1940) . .	£571 6 8					
South Australian 4 per cent. Bonds (1908-9) . . .	1,700 0 0			2,271 6 8		
Total . . £		415 0 0	...	2,271 6 8	12,500	...

ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.
By Grants to Widows and Orphans	156 5 6
,, Cash transferred to Capital Account	415 0 0
Total . . £	571 5 6

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Examined and found correct,
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

"CAPTAIN"

Dr. CAPITAL

RECEIPTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c	
			Home.	Indian and Colonial.	Home.	Indian and Colonial.
To Balance of Securities on 1st January, 1894 viz.:—	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£	£
Canada 4 per cent. Inscribed Stock (1910)	11,915 0 0					
Ceylon 4 per cent. Inscribed Stock (1934)	564 0 10					
New South Wales 5 per cent. Bonds (1889-1900)	6,700 0 0					
New South Wales 3½ per cent. Inscribed Stock (1918)	3,300 0 0					
South Australian 4 per cent. Bonds (1899-1909)	2,900 0 0					
South Australian 4 per cent. Inscribed Stock (1917-1936)	925 18 6					
			...	26,304 19 4		
,, Madras Railway 5 per cent. Stock		..	...	...	...	5,630
,, Cash, proceeds of Sale of £925 18s. 6d. South Australian 4 per cent. Inscribed Stock, as per contra		980 4 3				
,, Securities purchased on 6th November, viz :— Metropolitan Consolidated 3½ per cent. Stock, 1929		...	834 3 8			
,, Cash transferred from Income Account		264 11 2				
,, Securities transferred from General Fund, Capital Account, on 31st December, 1894, viz. :— Metropolitan Consolidated 3½ per cent. Stock, 1929		...	220 18 6			
Total	£	1,244 15 5	1,055 2 2	26,304 19 4	...	5,630

Dr. INCOME

RECEIPTS.		£ s. d.
To Balance on 1st January, 1894		0 13 11
,, Dividends received on undermentioned Securities, viz. :—	£ s. d.	
£11,915 Canada 4 per cent. Inscribed Stock	461 14 2	
£564 0s. 10d. Ceylon 4 per cent. Inscribed Stock	21 17 2	
£6,700 New South Wales 5 per cent. Bonds	324 10 8	
£3,300 New South Wales 3½ per cent. Inscribed Stock	115 10 0	
£2,900 South Australian 4 per cent. Bonds	112 7 6	
£925 18s. 6d. South Australian 4 per cent. Inscribed Stock April	17 19 6	
£5,630 Madras Railway 5 per cent. Stock	272 14 1	
		1,326 13 1
,, Income Tax repaid by Commissioners of Inland Revenue		36 15 4
Total	£	1,364 2 4

RELIEF FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Water Works &c.	
			Home.	Indian and Colonial.	Home.	Indian and Colonial.
		£ s. d.	£ s. d.	£ s. d.		£
By Sale of South Australian 4 per cent. Inscribed Stock, 15th of August, as per contra		...	...	925 18 6		
,, Cash paid for £834 8*s.* 8*d.* Metropolitan Consolidated 3½ per cent. Stock, as per contra		980 4 3				
By Cash transferred to General Fund, Capital Account, for £220 18*s.* 6*d.* Metropolitan Consolidated 3½ per cent. Stock (1929)		264 11 2				
		1,244 15 5	...	925 18 6	...	...
	£ s. d.					
By Balance of Securities on 31st Dec., 1894, viz.:—						
Canada 4 per cent. Inscribed Stock (1910)	11,915 0 0					
Ceylon 4 per cent. Inscribed Stock (1934)	564 0 10					
New South Wales 5 per cent. Bonds (1889-1900)	6,700 0 0					
New South Wales 3½ per cent. Inscribed Stock (1918)	3,300 0 0					
South Australian 4 per cent. Bonds (1899-1909)	2,900 0 0					
				25,379 0 10		
Madras Railway 5 per cent. Stock		...	...	...	...	5630
Metropolitan Consolidated 3½ per cent. Stock, 1929		...	1,055 2 2			
Total	£	1,244 15 5	1,055 2 2	26,304 19 4	...	5630

ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.
By Payment of Allowances to Widows, Orphans and Relatives	1,039 8 6
,, Commission on Post Office Orders	5 12 8
,, Cash transferred to General Fund Income Account on 31st December, viz.:— Proportion of Cost of Management at 4 per cent. on Income	54 10 0
,, Cash transferred to Capital Account	264 11 2
Total £	1,364 2 4

(*Signed*) J. S. YOUNG, Colonel.
Secretary.

Subject to observations in Report—examined and found correct,
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

"EURYDICE"

Dr. CAPITAL

RECEIPTS.	CASH.	Government and Municipal Securities		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.		£
To Balance of Securities on 1st January, 1894, viz. :— Queensland 4 per cent. Inscribed Stock, (1915) .			14,567 2 8		
,, Transfer from Royal Naval Relief Fund, Capital Account, Queensland 4 per cent. Inscribed Stock (1924), in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1915)	...	...	736 15 0		
,, Cash, proceeds of sale of £3,497 15*s.* 2*d.* Queensland 4 per cent. Inscribed Stock	3,607 10 8				
£3000 0*s.* 0*d.* Queensland 4 per cent. Inscribed Stock . . . . . as per contra.	3,108 14 0				
,, Securities purchased on 6th November, viz. :— Belfast Corporation 3½ per cent. Stock (1924) .	...	3,000 0 0			
Metropolitan Consolidated 3½ p. c. Stock (1929)	...	3,035 0 2			
,, Cash transferred from General Fund, Capital Account, on 31st December, 1894, to adjust error in transfer on 30th December, 1893, of £94 9*s.* 5*d.* Queensland 4 p. c. Inscribed Stock (1915), instead of £94 17*s.* 5*d.* . .	0 8 2				
,, Cash transferred from Income Account . .	97 14 8				
,, Securities transferred from General Fund, Capital Account, on 31st December, 1894, viz. :— Metropolitan Consolidated 3½ p. c. Stock (1929)	..	81 19 1			
Total £ . .	6,814 7 6	6,116 19 3	15,303 17 8	...	...

Dr. INCOME

RECEIPTS.	£ s. d.
To Dividends received on the undermentioned Securities, viz. :—	
£14,567 2*s.* 8*d.* Queensland 4 per cent. Inscribed Stock	582 13 8
Total . . £	582 13 8

RELIEF FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£	£
By Transfer to Royal Naval Relief Fund, Capital Account, of Queensland 4 per cent. Inscribed Stock (1915) in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1924)	...	...	736 15 0		
,, Sale of—					
Queensland 4 per cent. Inscribed Stock, 15th August	...	...	3,497 15 2		
Queensland 4 per cent. Inscribed Stock, 30th August	...	...	3,000 0 0		
as per contra.					
,, Cash paid for					
£3,000 Belfast Corporation 3½ per cent. Stock (1924)	3,150 1 0				
£3,035 0s. 2d. Metropolitan Consolidated 3½ per cent. Stock (1929)	3,566 3 8				
as per contra.					
,, Cash transferred to General Fund Capital Account, for					
£81 19s. 1d. Metropolitan Consolidated 3½ per cent. Stock (1929), as per contra . .	98 2 10				
	6,814 7 6	...	7,234 10 2	...	...
By Balance of Securities on 31st December, 1894, viz.:—					
Belfast Corporation 3½ per cent. Stock (1924) . . . £ 3,000 0 0					
Metropolitan Consolidated 3½ per cent. Stock (1929) . . 3,116 19 8		6,116 19 3			
Queensland 4 per cent. Inscribed Stock (1915) . . . 7,332 12 6					
Queensland 4 per cent. Inscribed Stock (1924) 736 15 0			8,069 7 6		
Total . . . £	6,814 7 6	6,116 19 3	15,303 17 8	...	...

ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.
By payment of Allowances to Widows and Orphans	344 12 6
,, ,, ,, ,, of Officers	115 10 0
,, Commission on Post Office Orders	1 16 6
,, Cash transferred to General Fund, Income Account, on 31st December, viz:—	
Proportion of Cost of Management at 4 per cent. on Income	23 0 0
,, Cash transferred to Capital Account	97 14 8
Total . . £	582 13 8

(Signed) J. S. YOUNG, Colonel,
Secretary.

Subject to observations in Report—examined and found correct,
(Signed) GEORGE H. TRIPP,
12th February, 1895.

ROYAL NAVAL

Dr. CAPITAL

RECEIPTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
			Home.	Indian and Colonial.	Home.	Indian and Colonial
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£	£
To Balance of Securities on 1st January, 1894, viz.:—						
Ceylon 4 per cent. Inscribed Stock (1934)	235 0 4					
Queensland 4 per cent. Inscribed Stock (1915)	6,219 18 2					
Queensland 4 per cent. Inscribed Stock (1924)	736 15 0					
South Australian 4 per cent. Bonds (1908-29)	600 0 0					
				7,791 18 6		
,, Amount of Wedding Present on Marriage to H.R.H. The Duke of York, received 16th February		50 0 0				
,, Transfer from "Eurydice" Relief Fund of Queensland 4 per cent. Inscribed Stock (1915) in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1924)		...	...	736 15 0		
,, Cash, proceeds of sale of £6,956 13*s.* 2*d.* Queensland 4 per cent. Inscribed Stock, as per contra		7,165 6 2				
,, Securities purchased, viz.:—						
Belfast Corporation 3½ per cent. Stock (1924) on 30th October			5,000 0 0			
Metropolitan Consolidated 3½ per cent. Stock (1929) on 6th November			1,656 11 3			
,, Cash transferred from Income Account		229 18 6				
,, Securities transferred from General Fund, Capital Account, on 31st December, 1894, viz.:—						
Metropolitan Consolidated 3½ per cent. Stock (1929)			233 11 0			
Total		7,444 19 8	6,890 2 3	8,528 8 6	...	...

Dr. INCOME

RECEIPTS.	£ s. d.	£ s. d.
To Dividends received on the undermentioned Securities, viz.:—		
£235 0*s.* 4*d.* Ceylon 4 per cent. Inscribed Stock	9 2 1	
£6,596 13*s.* 2*d.* Queensland 4 per cent. Inscribed Stock	278 5 4	
£600 0*s.* 0*d.* South Australian 4 per cent. Bonds	23 5 0	
		310 12 5
,, Income Tax repaid by Commissioners of Inland Revenue		0 19 6
Total		311 11 11

RELIEF FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railway Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£	£
By Transfer to "Eurydice" Relief Fund, Capital Account, of Queensland 4 per cent. Inscribed Stock (1924) in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1915) .	...	...	736 15 0		
„ Sale of Queensland 4 per cent. Inscribed Stock, 15th August, as per contra	...	...	6,956 13 2		
„ Cash paid for:—					
£5,000 Belfast Corporation 3¼ per cent. Stock (1924)	5,218 16 0				
£1,656 11s. 3d. Metropolitan Consolidated 3½ per cent. Stock (1929) as per contra	1,946 10 2				
„ Cash transferred to General Fund, Capital Account, for £233 11s. 0d. Metropolitan Consolidated 3½ per cent. Stock, as per contra .	279 13 6				
	7,444 19 8	...	7,693 8 2	...	...
By Balance of Securities on 31st December, 1894, viz.:—					
£ s. d.					
„ Belfast Corporation 3¼ per cent. Stock (1924) 5,000 0 0					
Metropolitan Consolidated 3½ per cent. Stock (1929) . . . 1,890 2 3		6,890 2 3			
Ceylon 4 per cent. Inscribed Stock (1934) 235 0 4					
South Australian 4 per cent. Bonds (1908-29) 600 0 0			835 0 4		
Total . . £	7,444 19 8	6,890 2 3	8,528 8 6	...	...

ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.
By Payment of Allowances to Widows and Orphans	69 11 6
„ Commission on Post Office Orders	0 6 11
„ Cash transferred to General Fund, Income Account, on 31st December, viz.:— Proportion of Cost of Management at 4 per cent. on Income	12 0 0
„ Cash transferred to Capital Account	229 13 6
Total . . £	311 11 11

(Signed) J. S. YOUNG, Colonel,
Secretary.

Subject to observations in Report—examined and found correct,
(Signed) GEORGE H. TRIPP,
12th February, 1895.

APPENDIX

ZULU WAR

CAPITAL

Dr.

RECEIPTS.	£ s. d.	CASH. £ s. d.	Government and Municipal Securities. Home. £ s. d.	Government and Municipal Securities. Indian and Colonial. £	Securities of Railways, Water Works, &c. Home. £	Securities of Railways, Water Works, &c. Indian and Colonial. £
To Balance of Securities on 1st January, 1894, viz. :—						
South Australian 4 per cent. Bonds (1907-9)	14,800 0 0					
Victoria 4½ per cent. Bonds (1904)	10,800 0 0					
				25,100		
,, Cash transferred from Income Account		364 4 0				
,, Securities transferred from General Fund, Capital Account, on 31st December, 1894, viz. :—						
Metropolitan Consolidated 3½ per cent. Stock (1929)		...	304 2 8			
Total £		364 4 0	304 2 8	25,100	...	...

Dr.

INCOME

RECEIPTS.	£ s. d.	£ s. d.
To Balance on 1st January, 1894		... 20 13 6
,, Dividends received on the undermentioned Securities, viz. :—		
£14,300 South Australian 4 per cent. Bonds	554 2 6	
£10,800 Victoria 4½ per cent. Bonds	470 16 3	
		1,024 18 9
,, Income Tax repaid by Commissioners of Inland Revenue		30 13 8
Total £		1,076 10 11

APPENDIX

"ATALANTA"

CAPITAL

Dr.

RECEIPTS.	CASH. £ s. d.	Government and Municipal Securities. Home. £	Government and Municipal Securities. Indian and Colonial. £	Securities of Railways, Water Works, &c. Home. £	Securities of Railways, Water Works, &c. Indian and Colonial. £
To Balance of Securities on 1st January, 1894, viz. —					
South Australian 4 per cent. Bonds (1907-29)	...	...	7,400		
Total £	...	...	7,400	...	...

Dr.

INCOME

RECEIPTS.	£ s. d.
To Balance on 1st January, 1894	57 16 11
,, Dividends received on the undermentioned Securities, viz. :—	
£7,400 South Australian 4 per cent. Bonds	286 15 0
,, Income Tax repaid by Commissioners of Inland Revenue	8 13 10
Total £	353 5 9

X.

FUND.

ACCOUNT, 1894.

Cr.

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
By Cash transferred to General Fund, Capital Account, for £304 2*s.* 8*d.* Metropolitan Consolidated 3½ per cent. Stock, as per contra	£ *s.* *d.* 364 4 0	£ *s.* *d.*	£	£	£
	364 4 0	...	...	...	...
By Balance of Securities on 31st December, 1894, viz.:—					
Metropolitan Consolidated 3½ per cent. Stock (1929)		304 2 8			
South Australian 4 per cent. Bonds (1907-9) £14,300 0 0					
Victoria 4½ per cent. Bonds (1904) £10,800 0 0			25,100		
Total £	364 4 0	304 2 8	25,100	...	...

ACCOUNT.

Cr.

EXPENDITURE.	£ *s.* *d.*
By Payment of Allowances to Widows and Orphans	373 1 6
,, ,, ,, ,, of Officers	288 9 6
,, ,, for Maintenance and Education of Orphans	7 8 8
,, Commission on Post Office Orders	1 7 8
,, Cash transferred to General Fund, Income Account, on 31st December, viz.:— Proportion of Cost of Management at 4 per cent. on Income	42 0 0
,, Cash transferred to Capital Account	364 4 0
Total £	1,076 10 11

(Signed) J. S. YOUNG, Colonel,
Secretary.

Examined and found correct.
(Signed) GEORGE H. TRIPP.
12th February, 1895.

XI.

RELIEF FUND.

ACCOUNT, 1894.

Cr.

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
To Balance of Securities on 31st December, 1894, viz.:— South Australian 4 per cent. Bonds (1907-29)	£ *s.* *d.* ...	£ ...	£ 7,400	£	£
Total £	...	...	7,400	...	...

ACCOUNT.

Cr.

EXPENDITURE.	£ *s.* *d.*
By Payment of Allowances to Widows and Orphans	173 16 6
,, ,, ,, ,, of Officers	156 15 9
,, Commission on Post Office Orders	0 15 4
,, Cash transferred to General Fund, Income Account, on 31st December, viz.:— Proportion of Cost of Management at 4 per cent. on Income	12 0 0
,, Balance on 31st December, 1894	343 7 7
	9 18 2
Total £	353 5 9

(Signed) J. S. YOUNG, Colonel,
Secretary.

Examined and found correct,
(Signed) GEORGE H. TRIPP,
12th February, 1895

Dr.

RECEIPTS.		CASH.	Government and Municipal Securities. Home.	Government and Municipal Securities. Indian and Colonial.	Securities of Railways, Water Works, &c. Home.	Securities of Railways, Water Works, &c. Indian and Colonial.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£
To Balance of Securities on 1st January, 1894, viz.:—						
Consols 2¾ per cent.		...	4,390 9 11			
	£ s. d.					
Bristol Water Works 3½ per cent. Perp. Debenture Stock	12,500 0 0					
East and West India Docks 4 per cent. Debenture Stock	6,812 0 0					
London and St. Katherine Docks 4 per cent. Debenture Stock	7,500 0 0				26,812 0 0	
New Zealand 4 per cent. Consolidated Stock (1929)	26,698 10 0					
New Zealand 3½ p. c. Inscrbd Stk. (1940)	9,007 11 10					
Queensland 4 p. c. Inscribed Stock (1924)	20,000 0 0					
South Australian 4 per cent. Inscribed Stock (1916-35)	11,000 0 0					
South Australian 4 p.c. Bonds (1907-16)	12,300 0 0					
West Australian 4 p. c. Bonds (1902)	9,400 0 0			88,406 1 10		
,, Securities transferred by War Office under Regimental Debts Act on 30th April, 1894, viz.:—						
Consols 2¾ per cent.		...	4,965 13 6			
,, Transfer from Roman Catholic Orphans' Fund, Capital Account, Queensland 4 per cent. Inscribed Stock (1915) in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1924)		...	...	15,000 0 0		
,, Cash, proceeds of Sale of						
£8,000 New Zealand 3½ per. cent Inscribed Stock		8,009 19 0				
£11,000 South Australian 4 per cent Inscribed Stock		11,653 0 6				
£15,000 Queensland 4 per cent. Inscribed Stock as per contra		15,449 18 0				
,, Securities purchased, viz.—						
Manchester Ship Canal 4 per cent. 1st Debenture (1914) on 28th August		...	...	...	3,500 0 0	
Manchester Ship Canal 4 per cent. 1st Debenture (1914) on 29th August		...	...	...	1,500 0 0	
Mersey Dock and Harbour Board 3½ per cent. Annuity on 26th September		...	...	...	6,000 0 0	
Leeds Corporation 4 p. c. Stock (1927) on 16th October		...	10,000 0 0			
Belfast Corporation 3¼ p.c Stock (1924) on 23rd October		...	5,000 0 0			
Manchester Ship Canal 4 per cent. 1st Debenture (1896) on 25th October		...	...	...	4,170 8 0	
Metropolitan Consolidated 3½ per cent. Stock (1929) on 6th November		...	1,802 5 10			
,, Cash transferred from Income Account		3,172 18 10				
,, Securities transferred on 31st December, 1894, viz.:—						
From General Fund, Capital Account, South Australian 4 per cent. Bonds (1907-8)		...	...	2,100 0 0		
From "Victoria" Relief Fund Portsmouth Corporation 3 per cent. Stock (1918-38)		...	960 11 5			
Total	£	38,285 16 4	27,119 0 8	105,506 1 10	41,982 8 0	...

Dr.

INCOME

RECEIPTS.		£ s. d.	£ s. d.
To Dividends received on the undermentioned Securities, viz.:—			
£4,390 9s. 11d. Consols 2¾ per cent.	(Jan. £80 8 9) (April £80 8 9)	189 0 6	
£9,356 3s. 5d. ,, ,,	(July £64 6 6) (Oct. £64 6 6)		
£12,500 Bristol Water Works 3½ per cent. Perpetual Debenture Stock		424 5 9	
£6,812 East and West India Dock 4 per cent. Debenture Stock		264 5 0	
£7,500 London and St. Katherine Docks 4 per cent. Debenture Stock		290 18 9	
£6,000 Mersey Dock and Harbour Board Annuities 3½ per cent.		2 15 7	
£26,698 10s. New Zealand 4 per cent. Consolidated Stock		1,067 18 8	
£9,007 11s. 10d. ,, 3½ ,, Inscribed Stock		315 5 2	
£20,000 Queensland 4 per cent. Inscribed Stock		800 0 0	
£11,000 South Australian 4 per cent. Inscribed Stock	April	213 11 8	
£12,300 South Australian 4 per cent. Bonds		476 12 6	
£9,400 West Australian 4 per cent. Bonds		364 5 0	
			4,408 18 7
,, Income Tax repaid by Commissioners of Inland Revenue			65 2 2
Total	£		4,474 0 9

EFFECTS FUND.

ACCOUNT, 1894.

Cr.

PAYMENTS.	CASH.			Government and Municipal Securities.						Securities of Railways, Water Works, &c.			
				Home.			Indian and Colonial.			Home.			Indian and Colonial.
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£
By transfer to Roman Catholic Orphans' Fund, Capital Account: Queensland 4 per cent. Inscribed Stock, (1924), in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1915) . . .	...			...			15,000	0	0				
Sale on 15th August of :—													
New Zealand 3½ per cent Inscribed Stock . . .	...			...			8,000	0	0				
South Australian 4 per cent. Inscribed Stock . .	...			...			11,000	0	0				
Queensland 4 per cent. Inscribed Stock . .	...			...			15,000	0	0				
as per contra.													
Cash paid for:—													
£3,500 Manchester Ship Canal 4 p. c. 1st Deb. (1914)	3,733	6	0										
£1,500 ,, ,, ,,	1,500	1	0										
£6,000 Mersey Dock and Harbour Board 3½ p.c. Annuity	6,000	0	0										
£10,000 Leeds Corporation 4 per cent. Stock (1927) .	12,199	6	0										
£5,000 Belfast Corporation 3¼ per cent. Stock (1924)	5,238	16	0										
£4,170 8*s.* Manchester Ship Canal 4 p. c. 1st Deb. (1896)	4,223	18	7										
£1,802 5*s.* 10*d.* Metropolitan Consolidated 3½ per cent. Stock (1929)	2,117	14	11										
as per contra													
Cash transferred :—													
To General Fund, Capital Account, for £2,100 South Australian 4 per cent. Bonds (1907-8)	2,178	15	0										
,, "Victoria Relief" Fund, for £960 11*s.* 5*d.* Portsmouth Corp. 3 p. c. Stk. (1913-33)	994	3	10										
as per contra													
	38,285	16	4	...			49,000	0	0	...			...
Balance of Securities on 31st Dec., '94, viz.:—	£	s.	d.										
Belfast Corporation 3¼ p. c. Stock (1924)	5,000	0	0										
Consols, 2¾ per cent.	9,356	8	5										
Leeds Corporation 4 p. c. Stock (1927)	10,000	0	0										
Metropolitan Consolidated 3½ p.c. Stk (1929)	1,802	5	10										
Portsmouth Corporation 3 per cent. Stock (1913-33)	960	11	5										
				2,7119	0	8							
Bristol Water Works, 3½ per cent. Perpetual Debenture Stock . .	12,500	0	0										
East and West India Dock 4 per cent. Debenture Stock	6,812	0	0										
London and St. Katherine Docks 4 per cent. Debenture Stock . . .	7,500	0	0										
Manchester Ship Canal 4 per cent. 1st Debenture (1896)	4,170	8	0										
Manchester Ship Canal 4 per cent. 1st Debenture (1914)	5,000	0	0										
Mersey Dock and Harbour Board 3½ per cent. Annuity	6,000	0	0										
										41,982	8	0	
New Zealand 4 per cent. Consolidated Stock (1929)	26,698	10	0										
New Zealand 3½ p. c. Inscribed Stock (1940)	1,007	11	10										
Queensland 4 p. c. Inscribed Stock (1924)	5,000	0	0										
South Australian 4 p. c. Bonds (1907-16)	14,400	0	0										
West Australian 4 per cent. Bonds (1902)	9,400	0	0										
							56,506	1	10				
Total . . . £	38,285	16	4	27,119	0	8	105,506	1	10	41,982	8	0	...

ACCOUNT.

Cr.

EXPENDITURE.	£	s.	d.
By Balance on 1st January, 1894	5	15	6
,, Payment of Allowances to Widows and Orphans	1,083	8	6
,, Fee for preparation of Estimate of Assets and Liabilities	5	5	0
,, Commission on Post Office Orders	5	8	9
,, Cash transferred to General Fund, Income Account, on 31st December, viz. :— Proportion of Cost of Management at 4 per cent. on Income	179	0	0
,, Cash transferred to Capital Account	3,172	18	10
	4,451	16	7
,, Balance on 31 December, 1894	22	4	2
Total . . . £	4,474	0	9

Subject to observations in Report—examined and found correct,

(*Signed*) J. S. YOUNG, Colonel, *Secretary.*

(*Signed*) GEORGE H. TRIPP, *12th February, 1895.*

ASHANTEE

Dr. CAPITAL

RECEIPTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
			Home.	Indian and Colonial.	Home.	Indian and Colonial.
To Balance of Securities on 1st January, 1894, viz. :—	£ s. d.	£ s. d.	£	£	£	£
New South Wales 4 per cent. Bonds (1903)	800 0 0					
South Australian 4 per cent. Bonds (1899)	400 0 0					
Victoria 4 per cent Bonds (1899)	800 0 0					
				2,000		
Total £		...	...	2,000	...	...

Dr. INCOME

RECEIPTS.		£ s. d.
To Balance on 1st January, 1894		71 17 1
,, Dividends received on the undermentioned Securities, viz :—	£ s. d.	
£800 New South Wales 4 per cent. Bonds	31 0 0	
£400 South Australian 4 per cent. Bonds	15 10 0	
£800 Victoria 4 per cent. Bonds	31 0 0	
		77 10 0
,, Income Tax repaid by Commissioners of Inland Revenue		2 7 10
Total £		151 14 11

APPENDIX

ZERVUDACHI

Dr. CAPITAL

RECEIPTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
			Home.	Indian and Colonial.	Home.	Indian and Colonial.
To Balance of Securities on 1st January, 1894, viz.:		£ s. d.	£ s. d.	£ s. d.	£	£
Consols 2¾ per cent.		...	182 18 8			
New Zealand 3½ per cent. Inscribed Stock (1940)		...	...	1,543 5 7		
,, Cash transferred from Income Account		59 0 10				
,, Securities transferred from General Fund, Capital Account, on 31st December, 1894, viz.:						
Consols 2¾ per cent.		...	57 8 8			
Total £		59 0 10	240 2 4	1,543 5 7	...	...

Dr. INCOME

RECEIPTS.		£ s. d.
To Dividends received on the undermentioned Securities, viz.:		
£182 18*s.* 8*d.* Consols 2¾ per cent.	£ s. d. 5 0 4	
£1,543 5*s.* 7*d.*, New Zealand 3½ per cent. Inscribed Stock	54 0 6	
		59 0 10
Total £		59 0 10

XIII.

WAR FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.	£ s. d.	CASH. £ s. d.	Government and Municipal Securities. Home. £	Government and Municipal Securities. Indian and Colonial. £	Securities of Railways, Water Works, &c. Home. £	Securities of Railways, Water Works, &c. Indian and Colonial. £
By Balance of Securities on 31st December, 1894, viz.:—						
New South Wales 4 per cent Bonds (1903)	800 0 0					
South Australian 4 per cent Bonds (1899)	400 0 0					
Victoria 4 per cent Bonds (1899)	800 0 0			2,000		
Total £		...	...	2,000	...	...

ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.
By Payment of Allowances to Widows	83 4 0
,, Commission on Post Office Orders	0 10 8
,, Cash transferred to General Fund, Income Account on 31st December, viz.— Proportion of Cost of Management at 4 per cent. on Income	3 0 0
	86 14 8
By Balance on 31st December, 1894.	65 0 3
Total £	151 14 11

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Examined and found correct,
(*Signed*) GEORGE H. TRIPP.
12th February, 1895.

XIV.

FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.	£ s. d.	CASH. £ s. d.	Government and Municipal Securities. Home. £ s. d.	Government and Municipal Securities. Indian and Colonial. £ s. d.	Securities of Railways, Water Works, &c. Home. £	Securities of Railways, Water Works, &c. Indian and Colonial. £
By Cash transferred to General Fund, Capital Account, for £57 3s. 8d. Consols 2¾ per cent. as per contra	59 0 10					
	59 0 10	...	...	...	...	...
,, Balance of Securities on 31st December, 1894, viz.:—						
Consols, 2¾ per cent.	...		240 2 4			
New Zealand 3½ per cent. Inscribed Stock (1940)	...		...	1,543 5 7		
Total £	59 0 10		240 2 4	1,543 5 7	...	...

ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.
By Cash transferred to Capital Account	59 0 10
Total £	59 0 10

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Examined and found correct.
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

LIGHT BRIGADE (BALACLAVA)

Dr. CAPITAL

RECEIPTS.	CASH.	Government and Municipal Securities		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£	£
To Balance of Securities on 1st January, 1894, viz. :— Cape of Good Hope 4½ per cent. Bonds, redeemable £1800 on 15th October, 1897, and £1,000 on 15th October, 1900	...	...	2,800 0 0		
,, Cash, proceeds of Cape of Good Hope 4½ per cent, Bonds paid off 16th April	100 0 0				
Total £	100 0 0	...	2,800 0 0	...	...

Dr. INCOME

RECEIPTS.	£ s. d.
To Balance on 1st January, 1894	25 5 4
,, Dividends received on the undermentioned Securities, viz. :— £2,800 0s. 0d. Cape of Good Hope 4½ per cent. Bonds, April £61 3s. 3d. / £2,700 0s. 0d. do. do. Oct. £58 14s. 6d.	119 17 9
,, Income Tax repaid by Commissioners of Inland Revenue	1 16 9
,, Cash transferred from Capital Account	100 0 0
Total £	246 19 10

COUNTY OF

Dr. CAPITAL

RECEIPTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
To Balance of Securities on 1st January, 1894, viz. :— Queensland 4 per cent. Inscribed Stock (1915)	...	...	815 16 5		
,, Cash proceeds of Sale of £815 16s. 5d. Queensland 4 per cent. Inscribed Stock, as per contra	840 4 11				
,, Securities purchased on 25th October, viz. :— Manchester Ship Canal 4 per cent. 1st Deb. (1896)	...	...	...	829 12 6	
Total £	840 4 11	...	815 16 5	829 12 0	...

Dr INCOME

RECEIPTS.	£ s. d.
To Balance on 1st January, 1894	14 15 5
To Dividend received on the undermentioned Securities, viz. :— £815 16s. 5d. Queensland 4 per cent. Inscribed Stock	32 12 6
Total £	47 7 11

RELIEF FUND.

ACCOUNT, 1894.

Cr.

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
By Cape of Good Hope 4½ per cent. Bond paid off 16th April, 1894	...	...	100 0 0		
,, Cash transferred to Income Account during the year	100 0 0				
,, Balance of Securities on 31st December, 1894, viz.:— Cape of Good Hope 4½ per cent. Bonds, redeemable £1,700 on 15th October. 1897, and £1,000 on 15th October, 1900	100 0 0 ...	...	100 0 0 2,700 0 0	...	...
Total	100 0 0	...	2,800 0 0	...	...

ACCOUNT.

Cr.

EXPENDITURE.	£ s. d.
By Payment of Allowances to 18 of the Survivors	170 7 6
,, Commission on Post-Office Orders	1 0 6
,, Cash transferred to General Fund, Income Account, on 31st December, viz.:— Proportion of Cost of Management at 4 per cent. on Income	5 0 0
	176 8 0
By Balance on 31st December, 1894	70 11 10
Total £	246 19 10

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Examined and found correct,
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

XVI.

FORFAR FUND.

ACCOUNT, 1894.

Cr.

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
By Sale of Queensland 4 per cent. Inscribed Stock 15th August, as per contra	...	...	815 16 5		
,, Cash paid for £829 12*s.* 0*d* Manchester Ship Canal 4 per cent. 1st Debentures	840 4 11				
	840 4 11	...	815 16 5	...	...
,, Balance of Securities on 31st December, 1894, viz.:— Manchester Ship Canal 4 per cent. 1st Debentures, (1896)	...	...	...	829 12 0	
Total £	840 4 11	...	815 16 5	829 12 0	...

ACCOUNT.

Cr.

EXPENDITURE.	£ s. d.
By Payment of Allowances	26 0 0
,, Commission on Post-Office Orders	0 2 8
,, Cash transferred to General Fund, Income Account, on 31st December, viz.:— Proportion of Cost of Management at 4 per cent. on Income	1 0 0
	27 2 8
By Balance on 31st December, 1894	20 5 3
Total £	47 7 11

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Subject to observations in Report—examined and found correct.
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

APPENDIX

"VICTORIA"

Dr.

CAPITAL

RECEIPTS.	CASH.	Government and Municipal Securities.		Securities of Railways Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£	£
To Balance of Securities on 1st January, 1894, viz. :—					
Liverpool Corporation 3½ per cent. Stock, non-redeemable £17,130 12 6					
Portsmouth Corporation, 3 per cent. Stock, (1913-33) 14,863 17 2					
Wigan Corporation, 3 per cent. Stock (1921) 15,150 0 0					
		47,144 9 8			
Manchester Ship Canal 4 per cent. 1st Debentures (Registered) 2nd Issue, (1914)	...	...	...	13,500	
Queensland 4 per cent. Inscribed Stock	...	...	2,230 14 7		
,, 5th Instalment of Fund from Sir Stuart Knill, received 4th January	2 18 0				
,, Subscription raised on board H.M.S. "Cleopatra," per Captain The Hon. A. G. Curzon-Howe, C.B., received 26th January	34 3 10				
,, Balance of Subscriptions raised at Portsmouth, received 26th January	5,535 0 0				
,, Donation, per E. E. Machen, Esq., 5th April . . .	1 13 0				
,, ,, from Lord Mayor, per Rev. F. J. Kiddle, 5th May	5 17 8				
,, Amount subscribed by Men on board H.M.S. "Victory," 14th June	0 10 1				
,, Donation from Masonic Lodge, Millbrook, Plymouth, 3rd July	5 5 0				
,, ,, ,, Mr. E. W. Hewitt, jun., 25th July . .	2 2 0				
,, Balance of Subscriptions raised at Malta	67 6 10				
,, Securities purchased on 16th June, 1894, viz. :— Mersey Dock and Harbour Board 3⅝ per cent. Annuities	...	...	...	4,700	
,, Cash transferred from Capital Account of "Soldiers' Effects" Fund for Securities transferred by this Fund, as per contra	994 3 10				
Total . . £	6,649 0 3	47,144 9 8	2,230 14 7	18,200	...

Dr.

INCOME

RECEIPTS.	£ s. d.
To Dividends received on the undermentioned Securities, viz. :—	
£17,130 12 6 Liverpool Corporation 3½ per cent. Stock	£599 11 4
13,500 0 0 Manchester Ship Canal 4 per cent. 1st Debentures . . .	523 2 6
14,863 17 2 Portsmouth Corporation 3 per cent. Stock	431 19 7
15,150 0 0 Wigan Corporation 3 per cent. Stock	440 5 11
2,230 14 7 Queensland 4 per cent. Inscribed Stock	89 4 8
4,700 0 0 Mersey Dock and Harbour Board 3⅝ per cent. Annuities . .	6 15 7
	2,090 19 7
,, Income Tax Repaid by Commissioners of Inland Revenue	21 0 2
,, Cash transferred from Capital Account	1,949 0 3
Total . . . £	4,061 0 0

RELIEF FUND.

ACCOUNT, 1894.

Cr.

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
By Cash paid for—	£ s. .	£ s. d.	£ s. d.	£	£
£4,700 Mersey Dock and Harbour Board 3⅝ per cent. Annuities, as per contra .	4,700 0 0				
,, Securities tranferred on 31st December, 1894, to "Soldiers' Effects" Fund, Portsmouth Corporation 3 per cent. Stock .	...	960 11 5			
,, Cash transferred to Income Account during the year	1,949 0 3				
	6,649 0 3	960 11 5	...	...	...
,, Balance of Securities on 31st December, 1894, viz :—	£ s. d.				
Liverpool Corporation 3½ per cent. Stock (non-redeemable) . . .	17,130 12 6				
Portsmouth Corporation 3 per cent. Stock (1913-33)	13,903 5 9				
Wigan Corporation 3 per cent. Stock (1921) . .	15,150 0 0				
		46,183 18 3			
Manchester Ship Canal 4 per cent. 1st Debentures (Reg.), 2nd Issue (1914) .	13,500 0 0				
Mersey Dock and Harbour Board 3⅝ per cent. Annuities	4,700 0 0			18,200	
Queensland 4 per cent. Inscribed Stock (1915)	...	...	2,230 14 7		
Total . . . . . £	6,649 0 3	47,144 9 8	2,230 14 7	18,200	...

ACCOUNT.

Cr.

EXPENDITURE.	£ s. d.
By Payment of Allowances to Widows, Orphans, and Dependent Relatives of Officers . . .	580 16 0
,, ,, ,, to Widows, Orphans, Dependent Relatives of other than Officers . .	3,367 13 3
,, Fee for preparation of Estimates of Assets and Liabilities	15 15 0
,, Commission on Post Office Orders	12 5 9
,, Cash transferred to General Fund, Income Account, on 31st December, viz : Proportion of Cost of Management at 4 per cent. on Income	84 10 0
Total . . . £	4,061 0 0

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Subject to observations in Report—Examined and found correct,
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

ROYAL VICTORIA ENDOWMENT FUND

Dr.

RECEIPTS.		CASH.	Government and Municipal Securities		Securities of Railways, Water Works, &c.	
			Home.	Indian and Colonial.	Home.	Indian Colonia
To Balance of Securities on 1st of January, 1894, viz.:—	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
Canada 4 per cent. Bonds (1904)	11,500 0 0					
Canada 4 per cent. Inscribed Stock	4,273 0 0					
Ceylon 4 p.c. Inscribed Stock (1934)	1,880 2 10					
India 3½ per cent. Stock	2,926 16 6					
New South Wales 3½ per cent. Inscribed Stock (1918)	27,600 0 0					
Queensland 4 per cent. Inscribed Stock (1915)	2,395 9 2					
Queensland 4 p. c. Inscrd. Stk. (1924)	3,502 12 2					
South Australian 4 per cent. Bonds (1899-1929)	28,500 0 0					
South Australian 4 p. cent. Inscribed Stock (1917-36)	9,662 2 3					
Victoria 4½ per cent. Bonds (1904)	10,200 0 0					
				102,440 2 11		
London and Greenwich Railway 4 per cent. Mortgage (payable 1st July, 1908)		...	...	...	50,000 0 0	
„ Cash, proceeds of Sale of £6,000 New South Wales 3½ p. c. Inscribed Stock		6,839 11 6				
£9662 2s. 3d. South Australian 4 p. c. „ „ as per contra		10,229 13 3				
„ Securities purchased, viz.:—						
Mersey Docks and Harbour Board 3½ per cent. Annuity, on 13th August		...	...	...	15,000 0 0	
Manchester Ship Canal, 4 per cent. 1st Debentures. (1914), on 15th August		...	...	...	1,000 0 0	
Metropolitan Consolidated 3½ per cent. Stock (1929) on 6th November.		...	857 4 11			
Total £		17,069 4 9	857 4 11	102,440 2 11	66,000 0 0	...

APPENDIX

RESERVE FUND

Dr.

RECEIPTS.		CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
			Home.	Indian and Colonial.	Home.	Indian and Colonial.
To Balance of Securities on 1st January, 1894, viz.:—	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£	£
Cape of Good Hope 4½ per cent. Bonds (redeemable by Annual Drawings of 1 per cent. accumulative)	500 0 0					
New South Wales 5 per cent. Bonds (1872-98)	3,900 0 0					
South Australian 4 per cent. Inscribed Stock (1917-36)	811 14 11					
				5,211 14 11		
„ Cash, proceeds of New South Wales 5 per cent. Bonds paid off 1st January, 1894		100 0 0				
„ Cash, proceeds of Sale of £811 14s. 11d. South Australian 4 per cent. Inscribed Stock, as per contra		859 7 9				
„ Securities purchased, viz.:—						
Metropolitan Consolidated 3½ per cent. Stock, (1929) on 6th November, 1894		...	731 7 10			
„ Dividends received on the undermentioned Securities, viz.:—						
£500 Cape of Good Hope 4½ per cent. Bonds		21 15 11				
£3,900 New South Wales 5 p.c. Bonds, Jan. £94 13 2						
£3,800 do. do. July, £91 16 8		186 9 10				
£811 14s. 11d. South Australian 4 per cent. Inscribed Stock April		15 15 3				
„ Income Tax repaid by Commissioners of Inland Revenue		6 16 4				
Total £		1,190 5 1	731 7 10	5,211 14 11	...	...

PATRIOTIC ASYLUM.

CAPITAL ACCOUNT, 1894.

Cr

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian & Co'onial.
By Sale on 15th August of :—	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£
New South Wales 3½ per cent. Inscribed Stock,	...	...	6,900 0 0		
South Australian 4 per cent. Inscribed Stock . .	...	...	9,662 2 3		
as per contra					
By Cash paid for :—					
£15,000 Mersey Dcks. & Harbour Brd. 3½ p. c. Annuity	1,5000 0 0				
£1,000 Manchester Ship Canal 4 p. c. 1st Deb. (1914).	1,061 18 6				
£857 4s. 11d. Metpltn. Consold. 3½ p. c. St., (1929).	1,007 6 3				
as per contra					
	17,069 4 9	...	16,562 2 3	...	...
By Balance of Securities on 31st December, 1894, viz. :—					
Canada 4 per cent. Bonds (1904) . 11,500 0 0					
Canada 4 per cent. Inscribed Stock . 4,273 0 0					
Ceylon 4 p. c. Inscribed Stock (1934) 1,880 2 10					
India 3½ per cent. Stock . . . 2,926 16 6					
Nw. Sth. Wales 3½ p.c. Inscd. Stk. (1918) 20,700 0 0					
Queensland 4 p.c. Inscrbd. Stk. (1915) 2,395 9 2					
,, ,, ,, (1924) 3,502 12 2					
Sth. Austrln. 4 p.c. Bnds. (1899-1929) 28,500 0 0					
Victoria 4½ per cent. Bonds (1904) . 10,200 0 0					
London and Greenwich Railway 4 p. c.			85,878 0 8		
Mortgage (Payable 1st July, 1908) 50,000 0 0					
Manchester Ship Canal 4 per cent. 1st					
Debenture, (1914). . . . 1,000 0 0					
Mersey Dcks. & Harbr. Bd. 3½ p.c. Annt. 15,000 0 0				66,000 0 0	
Metln. Consolidated 3½ p.c. Stk. (1929) ...	...	857 4 11			
NOTE.—A £1 Share in the Army and Navy Co-operative Society also belongs to the Official Trustees, though registered in the name of the Superintendent.					
Total . . £	17,069 4 9	857 4 11	102,440 2	66,000 0 0	...

XVIII. A.

ACCOUNT.

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways Water Works, &c	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
By New South Wales 5 per cent. Bonds, paid off 1st January, 1894	£ s. d. ...	£ s. d. ...	£ s. d. 100 0 0	£	£
,, Sale of South Australian 4 per cent. Inscribed Stock, 15th August, as per contra	...	...	811 14 11		
,, Cash paid for £731 7s. 10d. Metropolitan Consolidated 3½ per cent. Stock, as per contra	859 7 9				
,, Transfer of Cash under authority of Executive and Finance Committee, 14th November, 1894, to Building and Land Maintenance Account (R.V.P.A.)	330 17 4				
	1,190 5 1	...	911 14 11	...	..
,, Balance of Securities on 31st December, 1894, viz. :—					
Cape of Good Hope 4½ per cent. Bonds (redeemable by Annual Drawings of 1 per cent. accumulative) . . 500 0 0					
New South Wales 5 per cent. Bonds (1872-1898) 3,800 0 0			4,300 0 0		
Metropolitan Consolidated 3½ per cent. Stock (1929) .	...	731 7 10			
Total . . . £	1,190 5 1	731 7 10	5,211 14 11	...	...

(*Signed*) J. S. YOUNG, COLONEL,
Secretary.

Subject to observations in Report—examined and found correct.
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

APPENDIX

ROYAL VICTORIA

Dr.

INCOME

RECEIPTS.	£ s. d.	£ s. d.
To Dividends received on the undermentioned Securities, viz.:		
£11,500 Canada 4 per cent. Bonds	444 13 4	
£4,278 ,, ,, Inscribed Stock	165 4 6	
£1,880 2*s.* 10*d.* Ceylon 4 per cent. Inscribed Stock	72 17 2	
£2,926 16*s.* 6*d.* India 3½ per cent. Stock	102 8 8	
£27,600 New South Wales 3½ per cent. Inscribed Stock March £483 0 0		
£20,700 ,, ,, ,, Sept. £362 5 0	845 5 0	
£5,898 1*s.* 4*d.* Queensland 4 per cent. Inscribed Stock	235 18 4	
£18,400 South Australian 4 per cent. Bonds	713 0 0	
£10,100 ,, ,,	391 7 6	
£9,662 2*s.* 3*d.* ,, ,, Inscribed Stock. April	187 12 2	
£10,200 Victoria 4½ per cent. Bonds	444 13 2	
£50,000 London and Greenwich Railway 4 per cent. Mortgage	1,939 13 9	
£15,000 Mersey Docks and Harbour Board 3½ per cent. Annuities.	68 2 7	
£1 Share Army and Navy Co-operative Society	1 15 0	
		5,612 11 2
,, Income Tax repaid by Commissioners of Inland Revenue		135 14 10
,, Amount received for Maintenance and Education of Orphans, Greenwich Hospital Fund		182 0 11
,, Grants from Education Department		236 15 6
,, Rent of Farm	£108 8 4	
Income Tax repaid	4 1 8	
		112 10 0
,, Loan from Bank of England		766 16 1
Total £		7,046 8 6

APPENDIX

Dr.

BUILDING AND LAND

RECEIPTS.	£ s. d.
To Amount received for Grazing of Sheep on land	10 0 0
,, ,, ,, for Crop of Grass on field in Trinity Road	8 0 0
,, Amount transferred under authority of Executive and Finance Committee 14th November 1894, from Reserve Fund Account (R.V.P.A.)	330 17 4
,, Amount transferred from Income Account	1,305 11 11
Total £	1,649 9 3

PATRIOTIC ASYLUM.

ACCOUNT, 1894. *Cr.*

EXPENDITURE.	£ s. d.	£ s. d.
By Balances on 1st January, 1894	£12 15 0	
Less—Cash in hands of Superintendent £2 9 8½		
,, with Army and Navy Co-operative Society 5 15 5		
,, with Army and Navy Auxiliary Co-operative Supply 3 0 1		
	11 4 9½	
		1 10 2½
By Amount of Expenditure under the following heads, viz. :—		
Provisions	1,991 3 9½	
Water	89 0 0	
Fuel	883 7 6	
Light	88 7 7	
Laundry Stores	38 12 9½	
Household Stores	24 19 5	
Clothing and Outfits	663 18 4½	
Furniture and Repairs	211 7 9	
School Books and Stationery	56 3 4½	
Treats, Prizes, Good Conduct Rewards, and Gratuities	66 1 8	
Medicines and Medical Comforts	17 12 5	
Travelling expenses	39 17 0½	
Carriage	3 6 11	
Postage	18 0 0	
Miscellaneous	38 8 8	
Insurance	16 4 3	
Taxes	500 4 2	
Salaries and Wages	1,214 5 5	
,, Cash transferred to General Fund, Income Account, on 31st December, towards Cost of Management	262 0 0	
		5,723 1 1½
,, Cash transferred to Building and Land Maintenance Account		1,805 11 11
,, Interest on Loan		0 4 2
Cash in hands of Superintendent	5 3 3	
,, Army and Navy Co-operative Society	3 5 8½	
,, Army and Navy Auxiliary Co-operative Supply	7 12 1½	
		16
Average number of Girls, 290 ; cost per head, say, £19 14s. 8d. exclusive of charges for Maintenance of Buildings and Lands, see separate account below.		
Total		£ 7,046 8 6

XVIIIC.

MAINTENANCE ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.	£ s. d.
By Amount of Expenditure under the following heads, viz. :		
Ordinary Repairs	548 0 4	
New Work	851 18 5	
Engines	166 3 10	
Upkeep of Grounds	83 6 8	
		1,649 9 3
Total		£ 1,649 9 3

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Examined and found correct.
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

APPENDIX

THURLOW

Dr. CAPITAL

RECEIPTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£	£
To Balance of Securities on 1st January, 1894, viz :—					
Queensland 4 per cent. Inscribed Stock (1915) .	...	...	674 18 8		
,, Cash, proceeds of Sale of £674 18s. 8d. Queensland 4 per cent. Inscribed Stock, as per contra	695 2 7				
,, Securities purchased on 6th November :—					
Metropolitan Consolidated 3½ per cent. Stock (1929)	...	591 11 2			
Total . . .	695 2 7	591 11 2	674 18 8	...	...

INCOME

RECEIPTS.	£ s. d.
To Dividends received on the undermentioned Securities, viz :—	
£674 18s. 8d. Queensland 4 per cent. Inscribed Stock	27 0 0
Total . .	£ 27 0 0

APPENDIX

ROMAN CATHOLIC

Dr. CAPITAL

RECEIPTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£	£
To Balance of Securities on 1st January, 1894, viz :—					
Queensland 4 per cent. Inscribed Stock (1915) .	...	...	35,395 18 9		
,, Transfer from Soldiers' Effects Fund, Capital Account, Queensland 4 per cent. Inscribed Stock (1924), in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1915)	...	...	15,000 0 0		
,, Cash transferred from Income Account . .	116 12 7				
,, Securities transferred from General Fund, Capital Account, on 31st December, 1894, viz :—					
Queensland 4 per cent. Inscribed Stock (1915)	...	...	108 4 9		
	...				
Total . . £	116 12 7	...	50,504 3 6	...	...

Dr INCOME

RECEIPTS.	£ s. d.
To Dividends received on the undermentioned Securities, viz :—	
£35,395 18s. 9d. Queensland 4 per cent. Inscribed Stock	1,415 16 8
Total . £	1,415 16 8

XIX.

FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works, &c.	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
By Sale of Queensland 4 per cent. Inscribed Stock 15th August, as per contra . . .	...	...	674 18 8	...	...
,, Cash paid for £591 11*s.* 2*d.* Metropolitan Consolidated 3½ per cent. Stock, as per contra	695 2 7			...	...
	695 2 7	...	674 18 8	...	...
,, Balance of Securities on 31st Dec., 1894, viz.:— Metropolitan Consolidated 3½ per cent. Stock (1929)	...	591 11 2			
Total . . . £	695 2 7	591 11 2	674 18 8	..	...

ACCOUNT.

EXPENDITURE.	£ s. d.
By Payment of Allowances, Gratuities, &c.	12 17 6
,, Commission on Post Office Orders	0 0 9
	12 18 3
,, Balance on 31st December, 1894	14 1 9
Total . . £	27 0 0

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Subject to observations in Report—Examined and found correct,
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

XX.

ORPHANS' FUND.

ACCOUNT, 1894. *Cr.*

PAYMENTS.	CASH.	Government and Municipal Securities.		Securities of Railways, Water Works &c	
		Home.	Indian and Colonial.	Home.	Indian and Colonial.
	£ s. d.	£ . d.	£ s. d.	£	£
By transfer to Soldiers' Effects Fund, Capital Account, Queensland 4 per cent. Inscribed stock (1915) in exchange for same amount of Queensland 4 per cent. Inscribed Stock (1924)	...	...	15,000 0 0		
,, Cash transferred to General Fund, Capital Account, for £108 4*s.* 9*d.* Queensland 4 per cent. Inscribed Stock, as per contra . .	116 12 7				
	116 12 7	...	15,000 0 0	...	...
,, Balance of Securities on 31st Dec., 1894, viz:— Queensland 4 p. c. Inscribed Stock (1915) . . . £ 20,504 3 6 s. d.					
Queensland 4 p. c. Inscribed Stock (1924) . . . 15,000 0 0					
			35,504 3 6		
Total . . £	116 12 7	...	50,504 3 6	...	...

ACCOUNT. *Cr.*

EXPENDITURE.	£ s. d.
By Payment of Allowances for Maintenance and Education of Orphans	1,299 4 1
,, Cash transferred to Capital Account	116 12 7
Total . . £	1,415 16 8

(*Signed*) J. S. YOUNG, Colonel,
Secretary.

Examined and found Correct.
(*Signed*) GEORGE H. TRIPP,
12th February, 1895.

REPORT

OF THE

BOARD OF VISITORS,

APPOINTED BY THE

SECRETARY OF STATE FOR WAR,

FOR THE INSPECTION OF

THE ROYAL MILITARY COLLEGE, SANDHURST,

In the Year 1895.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
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BY HARRISON AND SONS, ST. MARTIN'S LANE,
PRINTERS IN ORDINARY TO HER MAJESTY.

And to be purchased, either directly or through any Bookseller, from
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1895.

[C.—7840.] *Price* 1½*d.*

Report of the Board of Visitors upon the Royal Military College, for the year 1895.

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1. The Board of Visitors inspected the Royal Military College on the 27th of June.

2. The Gentlemen Cadets were seen on parade under arms. Their appearance was very satisfactory. The health of the Cadets for the past year was stated to have been not so good as usual, owing to the severe epidemic of influenza which attacked the College this spring. No less than 111 admissions from this disease occurred, but, as a rule, the type was a mild one, only three or four cases having given rise to any anxiety. The average daily sick had been 4·27 out of an average strength of 367, giving a daily percentage of 1·16. The average height of the Cadets was 5 feet 9 inches, and their average age 20·29 years.

3. In 1893 the Board stated that the wooden canteen used by the subordinates, some 200 in number, was "dangerous, discreditable, and insanitary," and they recommended it should be removed for the safety of the adjacent buildings. Last year they again urged the necessity for the construction of a suitable building. At their last visit they found this canteen in a more evil condition than before, and can only say that, in addition to being a source of danger to adjacent buildings, it is a disgrace to any public establishment.

4. The Board drew attention last year to the extra wages paid from the mess funds to servants supposed to be paid by the public. On this occasion they inquired further into the matter, and were informed that the authorised rate of wages, viz., 18*s*. a week, is not sufficient, owing to the high rents demanded in the neighbourhood. Also, that it had been found more economical to increase the wages than to give food and beer, as formerly. The Board consider that it is most likely that the foregoing reasons do necessitate a higher rate of wages, but they are of opinion that an increase of 10*s*. a week is excessive, and that any increase should be paid by the public, and not by the cadets.

5. The Board were informed, with reference to paragraph 6 of their report for 1894, that the sum of 2,356*l*. alluded to therein was for the $2\frac{1}{2}$ years ending July, 1893. Since that date an officer has been appointed, who is paid by the War Department as mess secretary, and the mess accounts have been put on the footing considered advisable by the War Office, and are audited half yearly by that department. It was further stated that, in accordance with the recommendation of the special departmental committee, from whose report the figures above mentioned were taken, the depreciation fund is no longer treated as a separate fund, but has been brought back into the mess account, which now stands credited with the sum of 920*l*. The Board are of opinion that the recommendation in their last year's report as to the equipment of the mess should be adopted and strictly adhered to.

6. Referring to their remark last year, that the charge for wages against the trading accounts was excessive, the Board were informed that the various funds referred to are now charged a proportion of the profits they make, which goes towards the remuneration of those servants by whose services they benefit. The accounts of the several college funds are made up half yearly, and are audited by the War Department. The Board saw the balances for the term ending December 1894, which had been reduced to more moderate limits.

7. The Board were pleased to find that their remarks generally concerning unnecessary expenses have been attended to, and that the financial arrangements of the college are being, and have to a large extent been, placed on a more satisfactory footing, and that they are subject to regular official audit.

8. Referring to their opinion last year, that a re-arrangement of the time table was advisable, the Board inspected that now in use, and they still consider that it requires revision.

It appears that before the actual studies commence at 9.45 a.m., the cadets have been either drilling or riding from 6.30 to 7.30, and again from 8.30 to 9.30. The Board consider that the cadets should come to their studies as fresh as possible, and

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not fatigued, as they now must be, by so much physical exercise. It appears to the Board that too much time is devoted to drill at the expense of those technical studies which form the chief *raison d'être* of the College. In fact, that one hour daily is ample for instruction in drill. One of the hours of study which seems decidedly out of place is that from 2·15 to 3·15 p.m. The Cadets lunch at 1·20, and are therefore unlikely to be in a suitable condition for study, particularly in hot weather. Similarly, the study from 9 to 9·45 p.m. cannot be productive of much benefit to the students.

The Board, therefore, recommend that the hour before breakfast be devoted to study as heretofore, and that the evening study from 9 to 9·45 be discontinued, and that all studies should be under the supervision of instructors. This will not press unduly upon the teaching staff, as the Professors at present do not themselves instruct any class as do the Professors at the Royal Military Academy.

The Board also observe that there are two afternoons, Wednesday and Saturday in each week, on which there is no study nor military exercises, whereas at the Royal Military Academy Wednesday is treated in the same manner as other week days, and Saturday is the only weekly half holiday. They are of opinion that Wednesday afternoon should not be lost for purposes of study or military exercises.

9. The Board were informed that there are now only five cadets in excess of the establishment, and that none are living outside the College.

10. The Board were pleased to hear that their recommendation of a reduction in the cost of uniform had been attended to, and that the charge for uniform was now about the same at Sandhurst and Woolwich.

11. The recommendation that the study of French and German should be encouraged by allowing Cadets to take up one or other of these languages as a voluntary subject has not been attended to. The Board again call attention to this subject, and now recommend that French or German, at the option of the Cadet, should form part of the obligatory course of study at the College, in which proper instruction should be provided at the cost of the State.

12. The Board heard with satisfaction that their recommendation respecting the assimilation of the vacations at Woolwich and Sandhurst had been adopted, and that next year the vacations will be, as nearly as possible, coincident.

13. The Board have had before them the Standing Orders for both institutions, dated 1895. They are surprised to find that, although these establishments are maintained for the same purpose, viz., the education of young gentlemen, of about the same age, for service in the Army, the orders regulating the discipline, education, &c., differ widely in several essential points. The Board recommend that they be revised and made to agree as much as possible.

ARTHUR D. HAYTER.
J. L. A. SIMMONS, Field Marshal.
H. A. SMYTH, General.
ARTHUR LYTTELTON-ANNESLEY, Lt.-General.
JULIAN H. HALL, Lt.-General.

ALEX. DELAVOYE, Colonel,
Secretary.

16th August 1895.

APPENDIX A.

ROYAL MILITARY COLLEGE.

RETURN. 27th June 1895.

Distribution.	Staff Officers.								Educational Staff Officers		Gentleman Cadets.	Army Service Corps.						Ordnance Section, Armourer Sergeant.	Gymnastic Staff.	Permanent Staff.			Band Corps.				Cavalry Detachment.						
	Governor and Commandant.	Assistant Commandant and Secretary.	Quartermaster.	Riding Master.	Surgeon.	Assistant Surgeon.	Mess Secretary.	Chaplain.	Professors.	Instructors.		Staff Clerk Section. 1st Division.	Staff Clerk Section. 2nd Division.	Staff Clerk Section. 3rd Division.	Barrack Section. Colour Sergeant.	Barrack Section. Labourers.	Barrack Section. Gasman.			Sergeant-Major.	Quartermaster-Sergeant.	Staff Sergeants.	Bandmaster.	Sergeant.	Corporal.	Musicians.	Squadron Sergeant-Major.	Sergeants.	Staff-Sergeant Farrier.	Corporals.	Acting Shoeing Smith.	Privates.	Horses.
Effective Present	1	1	1	1	1	1	1	1	3	20	352	—	3	2	1	2	1	1	4	1	1	6	1	1	1	15	1	2	1	2	1	46	53
Sick	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Rusticated	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Absent with Leave	—	—	—	—	—	—	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1‡	—	—	—	—	—	—	—
Absent on Sick Leave	—	—	—	—	—	—	—	—	—	—	7†	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Absent without Leave	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	1	1	1	1	1	1	1	2	3	20	365	—	3	2	1	2	1	1	4	1	1	6	1	1	1	16	1	2	1	2	1	47	54
Over Establishment	—	—	—	—	—	—	—	1*	—	—	5	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1§	—
Wanting to complete	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Establishment	1	1	1	1	1	1	1	1	3	20	360	1	1	3	1	2	1	1	4	1	1	6	1	1	1	16	1	2	1	2	1	46	54

Distribution.	Royal Artillery.	Engineer Department.				Engineer Detachment.				Medical Staff Corps.		Temporarily Attached.									School.		Civilian Department.						Total.	
	Gunner.	Staff Engineer Clerk.	Sergeant-Major Foreman of Works.	Quartermaster-Sergeant Foreman of Works.	Civilian Labourers.	Sergeant-Major Instructor.	Sergeants.	Corporals.	Sappers.	Staff Sergeant.	Private.	Infantry Working Party. Officer.	Infantry Working Party. Sergeant.	Infantry Working Party. Corporals.	Infantry Working Party. Privates.	Acting Sergeant Instructor in Musketry.	Drill Instructors. Sergeants.	Sergts.' Mess. Private Waiter.	Sergts.' Mess. Private Cook.		Mistress.	Monitress.	Clerk (Pay Office).	Assistant Housekeepers.	Clerk of the Kitchen.	Servants, Messengers, &c.	Gatekeepers.	Workmen.	Draught Horses.	Persons.	Horses.
Effective Present	1	1	1	1	6	1	—	5	11	1	1	1	1	3	37	—	3	1	1		1	1	1	3	1	101	5	8	2	672	55
Sick	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	5	1
Rusticated	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—
Absent with Leave	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	4	—
Absent on Sick Leave	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	7	—
Absent without Leave	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—
Total	1	1	1	1	6	1	—	5	11	1	1	1	1	3	37	—	3	1	1		1	1	1	3	1	101	5	8	2	688	56
Over Establishment	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	1	—	—	—	10	—
Wanting to complete	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	2	—
Establishment	1	1	1	1	6	1	—	5	11	1	1	1	1	3	37	—	3	1	1		1	1	1	3	1	100	5	8	2	680	56

* Temporarily attached, during absence of Chaplain on leave.
‡ On Furlough pending discharge.
† Includes four on leave till end of term.
§ Awaiting discharge as an Invalid.

APPENDIX B.

Number of Gentlemen Cadets at each rate of Contribution.

Annual Rate, &c.	Number.	Remarks.
QUEEN'S CADETS	10	Free.
QUEEN'S INDIAN CADETS	16	Free.
At £20 per annum	3	
„ £40 „	42	
„ £60 „	81	
„ £70 „	8	
„ £80 „	3	
„ £150 „	202	
Total	365	

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APPENDIX C.

PROGRAMME of STUDIES and EXERCISES

Day.	Educational Division.	Drill, Riding, and Physical Training. 6.30 to 7.30 A.M.	Drill, Riding, and Gymnastics. 8.30 to 9.30.	1st Study. 9.45 A.M. to 1.15 P.M.	
				Branch.	Detail of Work.
Monday, 24/6/95.	1	A. B. C. and D.—Drill. E. and F.—Riding.	C. D. E. and F.—Drill. A. and B.—Riding.	Military Topography.	Class Instruction - - -
	2	A. B. C. and D.—Drill. E. and F. Gymnastics.	C. D. E. and F.—Drill. A. and B.—Gymnastics.	Fortification.	Class Instruction, 9.45 to 11.15 A.M.
					Classes I. and VI., Pile Bridges. 11.15 A.M. to 1.15 P.M.
					Classes II. and V., Ladders. 11.15 A.M. to 1.15 P.M.
					Classes III. and IV., Cask Piers. 11.15 A.M. to 1.15 P.M.
	3	Drill.	Drill.	Tactics, &c.	Lecture on Military Law, in No. 2 Lecture Hall, 9.45., and Class Instruction.
Tuesday, 25/6/95.	1	C. D. E. and F.—Drill. A. and B.—Riding.	A. B. E. and F.—Drill. C. and D.—Riding.	Tactics, &c.	Lecture on Administration in No. 2 Lecture Hall, 9.45., and Class Instruction.
	2	C. D. E. and F.—Drill. A and B.—Gymnastics.	A. B. E. and F.—Drill. C. and D.—Gymnastics.	Military Topography.	Class Instruction - - -
	3	Drill.	Drill.	Fortification.	Lecture in No. 1 Lecture Hall, 9.45 to 10.30 a.m.
					Class Instruction, 10.30 A.M. to 12.0 noon.
					Use of Gun Cotton near New Redoubt, 12 to 1.15 P.M.
Wednesday, 26/6/95.	1	C. D. E. and F.—Drill. A and B.—Riding.	A. B. C. and D.—Drill. E. and F.—Riding.	Fortification.	Classes II. and V. Water supply. Classes III. and IV. Visit types of roads. 9.45 to 11.30 A.M.
					Classes I. and VI. Visit types of roads. Classes III. and IV. Water supply. 11.40 to 1.15 P.M.
	2	C. D. E. and F.—Drill. A. and B.—Gymnastics.	A. B. C. and D.—Drill. E. and F.—Gymnastics.	Tactics.	Lecture on Military Law in No. 2 Lecture Hall, 9.45, and Class Instruction.
	3	Drill.	Drill.	Military Topography.	Class Instruction - - -

Day.	Educational Division.	Drill, Riding, and Physical Training. 6.30 to 7.30 A.M.	Drill, Riding, and Gymnastics. 8.30 to 9.30.	1st Study. 9.45 A.M. to 1.15 P.M.	
				Branch.	Detail of Work.
Thursday, 27/6/95.	1	A. B. E. and F.—Drill. C. and D.—Riding.	C. D. E. and F.—Drill. A. and B.—Riding.	Military Topography.	Class Instruction - - -
	2	A. B. E. and F.—Drill. C. and D.—Gymnastics.	C. D. E. and F.—Drill. A. and B.—Gymnastics.	Fortification.	Class Instruction till Out-door Work commences.
					Classes I. and VI., 4-leg Trestles, 11.40 to 1.15 P.M.
					Classes II. and V., Cask Rafts, 11.15 A.M. to 1.15 P.M.
					Classes III. and IV., Single Lock, 11.40 A.M. to 1.15 P.M.
	3	Drill.	Drill.	Tactics, &c.	Lecture on Tactics, in No. 2 Lecture Hall, 9.45 A.M., and Class Instruction.
Friday, 28/6/95.	1	A. B. C. and D.—Drill. E. and F.—Riding.	A. B. E. and F.—Drill. C. and D.—Riding.	Tactics, &c.	Lecture on Tactics, in No. 2 Lecture Hall, 9.45 A.M., and Class Instruction.
	2	A. B. C. and D.—Drill. E. and F.—Gymnastics.	A. B. E. and F.—Drill. C. and D.—Gymnastics.	Military Topography.	Class Instruction - - -
	3	Drill.	Drill.	Fortification.	Lecture in No. 1 Lecture Hall, 9.45 A.M. to 10.30 A.M., Class Instruction.

Day.	Educational Division.	Drill, Riding, and Physical Training, 6.30 to 7.30 A.M.	1st Study. 8.30 to 9.30 A.M.	Drill. 10.0 A.M. to 11.0 A.M.
Saturday, 29/6/95.	1	A. B. E. and F.—Drill. C. and D.—Riding.	Lecture on Military Law in No. 2 Lecture Hall.	Commandant's Parade.
	2	A. B. E. and F.—Drill. C. and D.—Gymnastics.	Lecture—Military Topography, in New Recreation Room.	
	3	Drill.	Lecture—Fortification, in No. 1 Lecture Hall.	

APPENDIX C.

for the Week ending 29th June 1895.

2nd Study 2,15 to 3.15 P.M.	Riding and Gymnastics. 3.45 to 4.45.	Riding and Gymnastics. 4.45 to 5.45.	Sword Drill. 6.15 to 6.45.	Sword Drill. 6.45 to 7.15.	3rd Study. 9 to 9.45.	Educational Division.	Day.
Military Topography. F. F. Plate III.	C. and D.—Riding.	——	A. and B.	E. and F.	Military Topography.	1	
	——	E. and F. Riding.	—	—	Notes XIII. to be completed and handed in on the 27th instant.	2	Monday, 24/6/95.
Fair Notes &c.	D. E. and F. Gymnastics.	A. B. and C.—Gymnastics.	—	—	Revision.	3	
Fair Notes &c.	E. and F.—Riding.	——	C. and D.	A. and B.	Revision.	1	
Military Topography.	——	A. and B.—Riding.	—	—	Military Topography.	2	Tuesday,
F. F. Plate II.	A. B. and C.—Gymnastics.	D. E. and F.—Gymnastics.	—	—	Notes IV.	3	25/6/95.

2nd Study. 2.15 to 3.15 P.M.	Riding and Gymnastics. 3.45 to 4.45.	Riding and Gymnastics. 4.45 to 5.45.	Sword Drill. 5.45 to 6.30.	Sword Drill. 6.30 to 7.15.	3rd Study, 9.0 to 9.45.	Educational Division.	Day.
Military Topography.	E. and F.—Riding.	——	A. and B.	C. and D.	Military Topography.	1	
F. F. Plate III. to be completed and sent to the Professor.	——	C. and D.—Riding.	—	—	Notes XIV.	2	Thursday, 27/6/95.
Fair Notes,&c.	D. E. and F.—Gymnastics.	A. B. and C.—Gymnastics.	—	—	Revision.	3	
FairNotes,&c.	A. and B.—Riding.	——	C. and D.	E. and F.	Revision.	1	
Military Topography.	——	E. F.—Riding.	—	—	Military Topography.	2	Friday, 28/6/95.
F. F. Plate II.	A. B. and C.—Gymnastics.	D. E. F.—Gymnastics.	—	—	Notes II. to be completed and handed in 3rd July.	3	

APPENDIX D.

RETURN showing the UNIVERSITIES, PUBLIC and other SCHOOLS at which the GENTLEMEN CADETS were educated.

Name of University or School.	Number.		
	Direct.	Assisted.	Total.
Barbados, Harrison College	—	1	1
Bath College	1	—	1
Bedford Grammar School	2	3	5
Bedford, Modern	5	5	10
Brighton College	1	4	5
Britannia, H.M. Ship	—	1	1
Canterbury, King's School	1	—	1
Cheltenham College	7	7	14
Clifton College	17	15	32
Cork, Queen's College	—	1	1
Cowes, The Grange	—	1	1
Dover College	—	3	3
Dublin, Black Rock College	—	1	1
Dulwich College	2	2	4
Dundee, High School	—	1	1
Eastbourne College	—	1	1
Edgebaston, The Oratory	1	1	2
Edinburgh, Mercheston	1	2	3
Eton College	10	17	27
Fareham, Eastman's R.N.A.	—	1	1
Felsted, Grammar School	—	1	1
Framlingham College	—	1	1
Glenalmond, Trinity College	1	1	2
Godalming, Charterhouse	2	10	12
Guernsey, Queen Elizabeth's College.	1	2	3
Harrow	7	13	20
Heidelberg College	—	1	1
Hertford, Haileybury College	1	6	7
Honiton, All Hallows	—	1	1
Inverness College	2	—	2
Isle of Man, King William's College.	—	3	3
Isle of Wight, Appledurcombe College.	1	—	1
Ipswich, Grammar School	—	1	1
Jersey, Victoria College	—	3	3
Kingston, Corrig School	—	2	2
Lancing College	1	1	2
Lausanne, Switzerland	—	1	1
Leatherhead, St. John's	—	1	1
London, Mercers	—	1	1
London Merchant Taylors	—	2	2
London, St. Paul's	1	7	8
London, University College School	—	1	1
Londonderry	—	1	1
Carried forward	65	127	192

Name of University or School.	Number.		
	Direct.	Assisted.	Total.
Brought forward	65	127	192
Loretto	—	1	1
Malvern College	1	3	4
Marlborough College	3	15	18
Melbourne, Australia	—	1	1
Musselburgh, Fette's College	1	—	1
Neuenheim College	1	—	1
Newcastle-under-Lyme	1	—	1
New Cross R.N. School	—	—	—
Newton Abbott College	1	1	2
Owen's School	—	1	1
Oxford Military College	3	4	7
Oxford, St. Edward's	1	—	1
Polmont, Blair Lodge	1	2	3
Portsmouth Grammar School	1	4	5
Plymouth, Mannamead	1	—	1
Radley College	—	3	3
Repton	—	2	2
Rossal	1	1	2
Rugby	6	5	11
St. Michaels	—	1	1
Sedberg	—	3	3
Sherborne	—	1	1
Shrewsbury	1	1	2
Southampton College	—	1	1
Southsea, St. Helen's College	—	1	1
Stonyhurst College	—	2	2
Stratford-on-Avon, Trinity College.	—	2	2
Sutton Valance	—	1	1
Swansea, Grammar School	—	1	1
Tavistock, Kelly's College	—	3	3
Tipperary, Grammar School	—	2	2
Tipperary, The Abbey	1	—	1
Tiverton, Blundells	3	—	3
Tonbridge	—	3	3
Uppingham	1	4	5
Wellington College	13	18	31
Westminster	—	1	1
Westward Ho!	3	4	7
Weymouth College	—	1	1
Winchester College	6	8	14
Windsor, Beaumont College	—	2	2
Windsor, St. Marks	—	1	1
Wolverhampton Grammar School	—	18	18
Private Schools	—	1	1
Total	115	250	365

APPENDIX E.

TABLE showing the Parentage of the GENTLEMEN CADETS.

Rank or Profession.	Total.	Rank or Profession.	Total.
Sons of Advocates	1	Brought forward	94
„ Artists	1	Sons of Justices of the Peace	4
„ Bankers	3	„ Medical Profession (civil)	4
„ Barristers	11	„ Members of Parliament	1
„ Brewers	2	„ Merchants	14
„ Civil Engineers	13	„ Officers of the Army	179
„ Civil Service	3	„ Officers of the Navy	4
„ Clergymen	25	„ Peers	3
„ Coal Factors	1	„ Publishers	1
„ Colonial Governor	1	„ Private Gentlemen	54
„ Doctor of Music	1	„ Solicitors	4
„ Indian Civil Service	27	„ Stock Brokers	1
„ Indian Planter	1	„ Schoolmasters	1
„ Judges	4	„ Land Agent	1
Carried forward	94	Total	365

APPENDIX F.

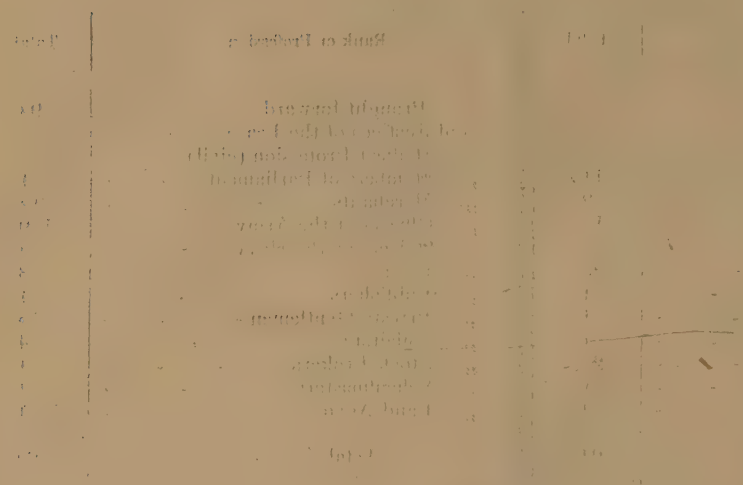
RETURN showing the NUMBER of GENTLEMEN CADETS who have lost a TERM.

Educational Division.	Number.				Remarks.
	By Sickness.	By Failure in Study.	By Rustication.	Total.	
First	*2	1	Nil	3	* One of these also lost a term by Failure in Study.
Second	†1	5	1	7	
Third	†3	2	Nil.	5	† On Sick Leave, and will consequently lose a term.
Total	6	8	1	15	

APPENDIX G.

RETURN showing the AVERAGE AGES of the GENTLEMEN CADETS on passing their FINAL EXAMINATIONS for COMMISSIONS in July and December, 1894, viz.:—

July 1894 - 20·41 years.
December 1894 - 20·18 „



REPORT

OF THE

BOARD OF VISITORS,

APPOINTED BY

THE SECRETARY OF STATE FOR WAR,

FOR THE INSPECTION OF

THE ROYAL MILITARY ACADEMY, WOOLWICH,

In the Year 1895.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY HARRISON AND SONS, ST. MARTIN'S LANE,
PRINTERS IN ORDINARY TO HER MAJESTY.

And to be purchased, either directly or through any Bookseller, from
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1895.

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Report of the Board of Visitors upon the Royal Military Academy, for the Year 1895.

1. The Board of Visitors inspected the Royal Military Academy on the 24th of June.

2. Two classes of Cadets were seen in the riding schools, and the junior division was seen on parade. The health of the Cadets was stated to have been very good during the past year, with the exception of the months of January and February, when a very large amount of sickness took place from bronchitis, sore throat, and simple continuant fever, followed by epidemic influenza. The average daily sick had been 2·32 out of an average strength of 207, giving a daily percentage of 1·07. The average height of the Cadets was 5 ft. 9½ ins. and their average age 19·8 years.

3. The Board for the fourth time recommend the construction of an additional drill shed, as set forth in their report last year. The Board consider this essential for the proper instruction of the Cadets.

4. The Board were informed that the Hospital had been altered, and is now in a good condition, and is capable of holding ten patients comfortably. They are of opinion that the building is now sufficient for ordinary cases. They, however, still consider that arrangements should be made at the Herbert Hospital for the reception of Cadets in cases of infectious disease of a serious type. They were informed that the construction of an infectious hospital, which they were given to understand last year had been proposed and recommended by the Director General, Army Medical Department, had not been provided for in the estimates of the current year.

5. Since the last inspection a 3-pr. Nordenfelt gun has been supplied. The Board are glad to observe that their recommendations of last year have been so far carried out, but they regret that the most important part of their recommendation, viz., that a proper B.L. gun and mounting should be supplied, has not been complied with.

6. The system of bifurcation, although adversely reported upon by successive Boards of Visitors, still continues in force. The Board consider it their duty again to direct attention to this very serious flaw in the educational arrangement of the Academy. The testimony of the late, as well as of the present Governor, whose opinion has been formed from the experience he has had of the young officers who have joined the Royal Engineers during the time he filled the position of Commandant of the School of Military Engineering, of the Commandant, and of the Professors, is unanimous in condemnation of the present system, under which there can be no doubt that, in addition to loss of incentive to work by a large portion of each batch, the instruction is not carried so far as it ought to be in some subjects. The Board are of opinion that bifurcation should be abolished and that the courses of study should be so regulated in future that the study of each subject should be carried so far as, and no further than, is alike advisable or necessary for Cadets about to be commissioned in either the Royal Artillery or Royal Engineers.

7. It has always been recognised that the instruction given at the Royal Military Academy requires to be supplemented, in the case of Officers who enter the Royal Engineers, before they can be considered competent to undertake the professional duties which the exigencies of the service may require, and, for the same reason that the School of Military Engineering has been established, it cannot be expected that Cadets can be turned out from the Academy fully instructed in the science and practice of gunnery, and qualified for the general duties of the Artillery service.

8. The Royal Commission of 1869 recommended that the education of young Artillery Officers should be continued after leaving the Academy by a thorough systematic course of instruction in practical Artillery, and that a short course at the School of Gunnery should form a regular part of the instruction of all young Officers of Artillery on first entering the service.

The Board having brought this strong recommendation, with which they entirely concur, to notice in previous reports, have now to express their regret that advantage has not been taken of the superabundance of Cadets who have of late left the Academy, qualified for commissions in the Royal Artillery, to send them to the School of Gunnery instead of allowing them to remain for nearly a year without occupation at the most critical period of their careers.

i p. 4371. 88150. Wt. 19963.

9. The Board were informed that of 22 Cadets who passed for commissions in the Royal Artillery in August, 1894, ten had not yet been commissioned; that of 29 Cadets who passed in March last, not one had received a commission; and that next month some 30 more Cadets will complete their course of studies and pass for commissions, not one of whom can be granted a commission until the 39 above referred to have been disposed of. The Board cannot but think that, considering the regulations now governing retirement and promotion of Officers, a closer calculation might have been made as to the probable demand for Officers, and that the admission of candidates to the Academy might have been so regulated as to accord more closely with the demand to supply vacancies. They observe that the delay in appointing these gentlemen to commissions operates with hardship upon the parents, and must tend to intensify the complaint so often made, that the highest on the roll of each batch as a rule select the Engineers. These young men find themselves superseded by their comrades who enter the Engineers, and by others in all branches of the service, and the delay in commissioning them may eventually compel their final retirement from the service in a lower rank than they might otherwise have attained, thus placing them at a serious disadvantage throughout their careers.*

10. The Board are informed that arrangements have been made within the last few months to send these young men, whilst waiting for appointment, to some of the larger Artillery stations, where they will be neither Officers nor Cadets; they understand that they are to be allowed to dine at mess with the Officers, but only in plain clothes. Being mere civilians attached for drill and not even living in Barracks, they will be in an anomalous position, neither capable of requiring obedience from the soldiers nor on a footing of social equality with the Officers.

11. The Board are of opinion that this practice is in direct contravention of the 28th paragraph of the Standing Orders of the Royal Military Academy which says that "at the end of the course those Cadets who are duly qualified will be gazetted to "commissions" in the Royal Artillery and Royal Engineers, and if it continue it may seriously affect the number and quality of the candidates for admission to the Royal Military Academy. They strongly recommend that when there are not vacancies to absorb Cadets when they complete their studies at and pass out of the Academy, they should be gazetted with temporary rank and paid as Officers and sent to the School of Gunnery until vacancies occur for their absorption, and that their permanent commissions should be back-dated, as was formerly the case with the Royal Engineers, to the date of their temporary commissions. If there should not be accommodation at the School of Gunnery for the large number who will be awaiting commissions next month, some of them might be sent to one or other of the large Artillery stations, or to the school in the Isle of Wight, but care should be taken that each one goes through a short course at Shoeburyness in compliance with the recommendation of the Royal Commission and of successive Boards of Visitors.

12. The attention of the Board was directed to the courses of some of the principal studies at the Academy as arranged after the system of bifurcation was introduced. It appears that the syllabus is overladen with subjects which are either never taught or for which there is not time to give thorough instruction in them. The Professors of Mathematics, Fortification, and Physical Science were all of opinion that the prescribed courses of study are too ambitious, that there is not time for giving proper instruction in them, and that they require modification so as to reduce them to what can be properly taught within the limits of time allotted for their study. This need not prevent the study of Higher Mathematics or other subjects by such cadets as are able in the opinion of the Professors to pursue them as voluntary subjects. The Board recommend that a re-arrangement of the courses of study should proceed simultaneously with the abolition of bifurcation.

The Board are also of opinion that marks should be given for Drills, Outdoor Exercises and Riding, as is done at the Royal Military College and was formerly the case at the Royal Military Academy. It is only right that those who are more attentive and are better than others in these respects should derive some advantage in the determination of places as they pass out from the Academy.

13. The Board were informed that a few more Cadets had attended the workshops since their last visit, and they hope, for the reasons stated in their last report, that that number will steadily increase.

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* *Note.*—Since the above was written, 31 Cadets have been gazetted to Commissions in the Royal Artillery, with ante-date.

14. The Board heard with satisfaction that their recommendations respecting the assimilation of the vacations at Woolwich and Sandhurst had been adopted, and that next year the vacations will be as nearly as possible coincident.

15. The Board have had before them the Standing Orders for both institutions dated 1895. They are surprised to find that, although these establishments are maintained for the same purpose, viz., the education of young gentlemen, of about the same age, for service in the Army, the orders regulating the discipline, education, etc., differ widely in several essential points. The Board recommend that they be revised and made to agree as much as possible.

ARTHUR D. HAYTER.
J. L. A. SIMMONS, Field Marshal.
H. A. SMYTH, General.
ARTHUR LYTTELTON ANNESLEY, Lt.-General
JULIAN H. HALL, Lt.-General.

A. M. DELAVOYE, Colonel,
Secretary.
10th August 1895.

APPENDIX A.

ROYAL MILITARY ACADEMY.

Woolwich, 24th June 1895.

Distribution.	Staff Officers and Professors.								Gentlemen Cadets.	Detachment, R.A.									Detachment R.E.			Detachment, M.S. Corps.		Civil Department.								Academy Servants.		Total.	
	Governor.	Assistant Commandant.	Lieutenants of Cadet Company.	Adjutant and Quartermaster.	Chaplain.	Medical Officer.	Professors and Instructors.	Total.		Sergeant-Major.	Quartermaster-Sergeant.	Gunnery Instructor.	Gymnastic Instructors.	Staff Sergeants.	Superintending Clerks.	Staff Clerks.	Trumpeters.	Gunners (Officers' Servants).	Serjeant-Major.	Quartermaster-Sergeant.	Rank and File.	Sergeants.	Privates.	Modeller.	Modelling Smith.	Modeller's Boy.	Chemical Assistant.	Laboratory Boy.	Draughtsman.	Smith and Engine Driver.	Master Tailor.	Male.	Female.	Persons.	Horses.
Effective present	1	1	2	1	–*	1	28	34	208	1	1	1	3	6	2	3	2	4	1	1	–	–	–	1	1	1	2	1	1	1	1	75	7§	358	1
Sick in hospital	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sick at home	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	3	–
Rusticated	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Absent with leave (sick)	–	–	1	–	–	–	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–
Absent without leave	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
In quarantine	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–
Total	1	1	3	1	–*	1	29†	36	208	1	1	1	3	7	2	3	2	4	1	1	–	–	–	1	1	1	2	1	1	1	1	79	7	365	1
Over establishment	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Wanting to complete	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
Establishment	1	1	3	1	–*	1	29†	36	208	1	1	1	3	7	2	3	2	5	1	1	–	–	–	1	1	1	2	1	1	1	1	79	7	366	1
Attached	–	–	1	–	–	–	1	2	–	–	–	–	–	–	–	2‡	–	–	–	–	6	1	3	–	–	–	–	–	–	–	–	–	–	14	–

* A Garrison Chaplain officiates.

† Includes two temporary Instructors.

‡ Two Corporals (temporary).

§ Includes five Servants' Wives, dusting Class Rooms.

APPENDIX B.

ABSTRACT showing the Public and other Schools at which the GENTLEMEN CADETS of the ROYAL MILITARY ACADEMY were educated.

School at which educated.	Direct.	Assisted.	Total.
Eton College	3	4	7
Harrow School	5	3	8
Winchester College	2	1	3
Rugby School	2	—	2
Shrewsbury School	1	—	1
Sherborne School	1	—	1
Charterhouse	4	7	11
Westminster School	—	3	3
St. Paul's School, West Kensington	9	2	11
Dulwich College	3	4	7
Radley College	1	—	1
Repton School	2	—	2
Uppingham School	5	1	6
Haileybury College	—	6	6
Cheltenham College	16	—	16
Clifton College	12	—	12
Wellington College	8	1	9
Marlborough College	4	5	9
United Service College, Westward Ho'	3	1	4
Oxford Military College	—	1	1
Malvern College	1	1	2
Newton Abbott College	2	1	3
Fettes College	—	2	2
Merchiston Castle School	—	1	1
Edinburgh Academy	—	2	2
Dollar Institution	—	1	1
Blair Lodge School	1	—	1
Dover College	1	1	2
Bath College	2	—	2
Lancing College	1	—	1
Brighton College	1	—	1
Bradfield College	3	2	5
Mercer's School, London	—	1	1
Bedford Grammar School	11	2	13
Portsmouth Grammar School	4	1	5
Tonbridge Grammar School	2	—	2
Highgate Grammar School	1	—	1
Blundell's School, Tiverton	1	—	1
Sedbergh School, Yorks	—	1	1
Victoria College, Jersey	—	1	1
Eastbourne College	1	1	2
Wimbledon School	—	1	1
Queen Elizabeth's School, Ipswich	1	—	1
Ipswich College	1	—	1
Beaumont College, Old Windsor	—	1	1
Royal School, Armagh	—	1	1
Allhallow's School, Honiton	1	—	1
Isle of Wight College	1	—	1
Kings' School, Canterbury	1	—	1
Trinity College, Glenalmond	1	—	1
Kings' School, Rochester	—	1	1
Private, Foreign, and other Schools	7	21	28
Total	126	82	208

APPENDIX C.

TABLE showing the Parentage of the GENTLEMEN CADETS.

Rank or Profession.	No.
Peers	1
Baronets	1
Members of Parliament	—
Officers of the Army	105
Officers of the Navy	5
Clergymen	6
Legal Profession	9
Medical Profession	7
Civil Service	18
Other Professions	20
Private Gentlemen, Merchants, &c.	36
Total	208

APPENDIX D.

NUMBER of CADETS at each Rate of Contribution.

Rates of Payments.	No. of Cadets.
Queen's Cadet	1
At £20 per annum	3
„ £40 „	29
„ £60 „	55
„ £70 „	6
„ £80 „	2
„ £150 „	112
Total	208

APPENDIX E.

RETURN showing the AVERAGE AGE of CADETS recommended for COMMISSIONS during the past Year.

—	Years.	Months.
August 1894	19	7
March 1895	19	10

APPENDIX F.

MEMORANDUM as to the NUMBER of GENTLEMEN CADETS who have lost a Term through Failure at Examination, Sickness, or otherwise, during the past year.

Through failure, nil.
(There were several failures, but they were specially dealt with and all passed up).
Through sickness, 6.
Through rustication, 2.
Withdrawn from Royal Military Academy, 3.
Died, 1.

APPENDIX G.

WEEKLY DETAIL OF STUDIES AND DRILLS.

APPENDIX

Weekly Detail of

Day.	1st Class. Artillery Division.			1st Class. Engineer Division.			2nd Class. Artillery Division.		
	Study.	Hours.	Subject.	Study.	Hours.	Subject.	Study.	Hours.	Subject.
Monday	1st	8.15 a.m. to 9.45 a.m.	Artillery.	1st	8.15 a.m. to 9.45 a.m.	Mathematics.	1st and 2nd	8.15 a.m. to 3.0 p.m.	Military Topography.
	2nd	10.0 a.m. to 11.0 a.m.		2nd	10.0 a.m. to 11.0 a.m.	Landscape Drawing.			
		11.30 a.m. to 12.30 p.m.	Riding Drill.		11.30 a.m. to 12.30 p.m.	Riding Drill.			
					4.0 p.m. to 5.0 p.m. (compulsory)	Fortification.	Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.
	3rd	5.15 p.m. to 7.15 p.m.	Artillery.	3rd	5.15 p.m. to 7.15 p.m.	Fortification.	3rd	5.15 p.m. to 7.15 p.m.	Fortification.
Tuesday	1st and 2nd	8.15 a.m. to 3 p.m.	Military Topography.	1st and 2nd	8.15 a.m. to 3.0 p.m.	Military Topography.		8.30 a.m. to 9.30 a.m.	Riding Drill.
								9.45 a.m. to 1.0 p.m.	½ Class at Arsenal.
							1st	10.30 a.m. to 11.45 a.m.	½ Class, Artillery.
							2nd	12.0 noon to 1.0 p.m.	
	Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.						
	3rd	5.15 p.m. to 7.15 p.m.	Tactics.	3rd	5.15 p.m. to 7.15 p.m.	Tactics.	3rd	5.15 p.m. to 7.15 p.m.	Electricity.
Wednesday		8.30 a.m. to 9.30 a.m.	Riding Drill.		8.30 a.m. to 9.30 a.m.	Riding Drill.	1st	8.15 a.m. to 9.45 a.m.	Fortification.
		9.45 a.m. to 1.0 p.m.	½ Class, at Arsenal.		9.45 a.m. to 1.0 p.m.	½ Class at Arsenal.	2nd	10.0 a.m. to 11.45 a.m.	
	1st	10.30 a.m. to 11.45 a.m.	½ Class, Artillery.	1st	10.30 a.m. to 11.45 a.m.	½ Class, Artillery. ½ Class, Mathematics.		12.0 noon to 1.0 p.m.	Artillery Exercises.
	2nd	12.0 noon to 1.0 p.m.		2nd	12.0 noon to 1.0 p.m.				
	3rd	5.15 p.m. to 7.15 p.m.	Fortification.	3rd	5.15 p.m. to 7.15 p.m.	Mathematics.	3rd	5.15 p.m. to 7.15 p.m.	Artillery.
Thursday	1st	8.15 a.m. to 9.45 a.m.	Fortification.	1st	8.15 a.m. to 9.45 a.m.	Artillery.	1st	8.15 a.m. to 9.45 a.m.	Artillery Exercises.
	2nd	10.0 a.m. to 11.0 a.m.		2nd	10.0 a.m. to 11.0 a.m.		2nd	10.0 a.m. to 11.45 a.m.	
		11.30 a.m. to 12.30 p.m.	Riding Drill.		11.30 a.m. to 12.30 p.m.	Riding Drill.		12.0 noon to 1.0 p.m.	Sword Drill.
	Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.					2.30 p.m. to 3.30 p.m.	Riding Drill.
	3rd	5.15 p.m. to 7.15 p.m.	Electricity.	3rd	5.15 p.m. to 7.15 p.m.	Electricity.	3rd	5.15 p.m. to 7.15 p.m.	Artillery.
Friday	1st	8.15 a.m. to 9.45 a.m.	Artillery Exercises.	1st	8.15 a.m. to 9.45 a.m.	Fortification.	1st	8.15 a.m. to 9.45 a.m.	Tactics.
	2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.	Artillery Exercises.
		12.0 noon to 1.0 p.m.	Battalion Drill.		12.0 noon to 1.0 p.m.	Battalion Drill.		12.0 noon to 1.0 p.m.	Battalion Drill.
		2.30 p.m. to 3.30 p.m.	Riding Drill.		2.30 p.m. to 3.30 p.m.	Riding Drill.			
							Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.
	3rd	5.15 p.m. to 7.15 p.m.	Tactics.	3rd	5.15 p.m. to 7.15 p.m.	Tactics.	3rd	5.15 p.m. to 7.15 p.m.	Electricity.
Saturday	1st	8.15 a.m. to 10.15 a.m.	Electricity.	1st	8.15 a.m. to 10.15 a.m.	Electricity.	1st	8.15 a.m. to 9.45 a.m.	Artillery.
		10.45 a.m. to 11.30 a.m.	Riding Drill.		10.45 a.m. to 11.30 a.m.	Riding Drill.	2nd	10.0 a.m. to 11.30 a.m.	

G.

Studies and Drills.

2nd Class. Engineer Division.			3rd Class.			4th Class.			Day.
Study.	Hours.	Subject.	Study.	Hours.	Subject.	Study.	Hours.	Subject.	
1st and 2nd	8.15 a.m. to 3.0 p.m.	Military Topography.	1st	8.15 a.m. to 9.45 a.m.	Fortification.	1st	8.15 a.m. to 9.45 a.m.	Mathematics.	Monday.
			2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		
				12.0 noon to 1.0 p.m.	Gun Drill.		12.0 noon to 1.0 p.m.	Squad Drill or Gymnastics	
				2.30 p.m. to 3.30 p.m.	Riding Drill.		2.10 p.m. to 3.10 p.m.		
						Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.	
3rd	5.15 p.m. to 7.15 p.m.	Landscape Drawing.	3rd	5.15 p.m. to 7.15 p.m.	French or German.	3rd	5.15 p.m. to 7.15 p.m.	Chemistry and Physics.	
	8.30 a.m. to 9.30 a.m.	Riding Drill.	1st	8.15 a.m. to 9.45 a.m.	Mathematics.	1st	8.15 a.m. to 9.45 a.m.	Fortification.	Tuesday.
	9.45 a.m. to 1.0 p.m.	½ Class at Arsenal.	2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		
1st	10.30 a.m. to 11.45 a.m.	½ Class, Artillery.		12.0 noon to 1.0 p.m.	Gun Drill.		12.0 noon to 1.0 p.m.	Squad Drill or Gymnastics	
2nd	12.0 noon to 1.0 p.m.			2.15 p.m. to 3.15 p.m.	Riding Drill.		2.10 p.m. to 3.10 p.m.		
			Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.		4.0 p.m. to 5.0 p.m.	French or German.	
3rd	5.15 p.m. to 7.15 p.m.	Electricity.	3rd	5.15 p.m. to 7.15 p.m.	French or German.	3rd	5.15 p.m. to 7.15 p.m.	Mathematics.	
1st	8.15 a.m. to 9.45 a.m.	Fortification.	1st	8.15 a.m. to 9.45 a.m.	Military Topography	1st	8.15 a.m. to 9.45 a.m.	Chemistry and Physics.	Wednesday.
2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		
	12.0 noon to 1.0 p.m.	Artillery Exercises.		12.0 noon to 1.0 p.m.	Gun Drill.		12.0 noon to 1.0 p.m.	Squad Drill or Gymnastics	
							2.10 p.m. to 3.10 p.m.		
3rd	5.15 p.m. to 7.15 p.m.	Fortification.	3rd	5.15 p.m. to 7.15 p.m.	Chemistry and Physics.	3rd	5.15 p.m. to 7.15 p.m.	Mathematics.	
1st	8.15 a.m. to 9.45 a.m.	Mathematics.	1st	8.15 a.m. to 9.45 a.m.	Mathematics.	1st	8.15 a.m. to 9.45 a.m.	Military Topography	Thursday.
2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		
	12.0 noon to 1.0 p.m.	Sword Drill.		12.0 noon to 1.0 p.m.	Gun Drill.		12.0 noon to 1.0 p.m.	Gymnastics.	
				2.10 p.m. to 3.10 p.m.	Gymnastics.		2.10 p.m. to 3.10 p.m.	Squad Drill.	
	2.30 p.m. to 3.30 p.m.	Riding Drill.	Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.		4.0 p.m. to 5.0 p.m. (compulsory)	French or German.	
3rd	5.15 p.m. to 7.15 p.m.	Artillery.	3rd	5.15 p.m. to 7.15 p.m.	Mathematics.	3rd	5.15 p.m. to 7.15 p.m.	Model Drawing.	
1st	8.15 a.m. to 9.45 a.m.	Tactics.	1st	8.15 a.m. to 9.45 a.m.	Chemistry and Physics.	1st	8.15 a.m. to 9.45 a.m.	Fortification.	Friday.
2nd	10.0 a.m. to 11.45 a.m.	Mathematics.	2nd	10.0 a.m. to 11.45 a.m.		2nd	10.0 a.m. to 11.45 a.m.		
	12.0 noon to 1.0 p.m.	Battalion Drill.		12.0 noon to 1.0 p.m.	Battalion Drill.		12.0 noon to 1.0 p.m.	Battalion Drill or Gymnastics.	
				2.10 p.m. to 3.10 p.m.	Gymnastics.		2.10 p.m. to 3.10 p.m.	Squad Drill.	
						Vol.	4.0 p.m. to 5.0 p.m.	Landscape Drawing.	
3rd	5.15 p.m. to 7.15 p.m.	Electricity.	3rd	5.15 p.m. to 7.15 p.m.	Model Drawing.	3rd	5.15 p.m. to 7.15 p.m.	French or German.	
1st	8.15 a.m. to 9.45 a.m.	Fortification.	1st	8.15 a.m. to 9.45 a.m.	Fortification.	1st	8.15 a.m. to 9.45 a.m.	Military Topography	Saturday.
2nd	10.0 a.m. to 11.30 a.m.		2nd	10.0 a.m. to 11.30 a.m.		2nd	10.0 a.m. to 11.30 a.m.		

ALKALI, &c. WORKS REGULATION ACT, 1881.

THIRTY-FIRST ANNUAL REPORT

ON

ALKALI, &c. WORKS,

BY THE

CHIEF INSPECTOR.

PROCEEDINGS DURING THE YEAR 1894

PRESENTED TO THE

LOCAL GOVERNMENT BOARD

AND TO THE

SECRETARY FOR SCOTLAND.

(*Presented pursuant to Act* 44 *&* 45 *Vict. c.* 37.)

Ordered, by The House of Commons, *to be Printed,*
9 *April* 1895.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

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ALKALI, &c. WORKS

BY

THE CHIEF INSPECTOR.

PROCEEDINGS DURING THE YEAR 1894

TO THE LOCAL GOVERNMENT BOARD.

My Lords and Gentlemen,

I have the honour of presenting my report of the work done under the provisions of the Alkali, &c. Works Regulation Act during the year 1894.

There have been no changes among the inspectors or sub-inspectors, and although a considerable increase in the work has been caused by the operation of the Amended Act of 1892, yet there has been no addition to the working staff.

The number of works now registered in England, Ireland, and Wales, under the Act is 1,056, of these 102 only are alkali works proper, while 954 come under the schedules of other works which have more recently come under its provisions. These numbers show an increase of one alkali work and of nine other works since 1893.

Number of Registered Works.

—	Dist. I.—Ireland.	Dist. II.—North of England.	Dist. III.—Cheshire, N. Wales, and part of Lancashire.	Sub-Dist.—Widnes.	Dist. IV.—East Lancashire and Part of Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England and South Wales.	Dist. VII.—South-Eastern Counties.	Total. 1894.	Total. 1893.	Total. 1892.
Alkali works	2	14	15	15	30	9	6	11	102	101	100
Other works	50	104	94	10	161	157	179	199	954	945	810
Total	52	118	109	25	191	166	185	210	1,056	1,046	910

There are also 126 works registered in Scotland, bringing the total number of registered works to 1,182. Concerning the Scotch works a separate report is presented to Her Majesty's Secretary for Scotland.

The amount of work undertaken by the inspectors under the Alkali Act is, however, best shown by reference to the number of separate manufacturing processes which are under inspection. Several separate processes are often carried on at one factory, and in that case are included under one registration, but each process receives special examination. The number of such processes of manufacture in England, Ireland, and Wales is 1,520, which number is an increase of 25 upon that of 1893. The following table shows the distribution of these processes among the eight districts and sub-districts, and also gives the name descriptive of the various manufactures :—

SEPARATE PROCESSES of MANUFACTURE.

—	Dist. I.—Ireland.	Dist. II.—North of England.	Dist. III.—Cheshire, N. Wales, and Part of Lancashire.	Sub-Dist.—Widnes.	Dist. IV.—East Lancashire and Part of Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England and South Wales.	Dist. VII.—South-East of England.	Total. 1894.	Total. 1893.	Total. 1892.
Alkali	2	10	12	13	13	3	3	3	59	58	57
Copper (wet process)	—	4	3	3	2	2	2	—	16	16	17
Sulphuric acid	12	19	17	13	36	26	35	28	186	192	199
Chemical manure	17	38	13	2	9	46	36	45	206	209	214
Gas liquor	—	2	7	3	20	2	—	2	36	35	33
Nitric acid	—	3	4	—	40	18	3	21	89	85	91
Sulphate and muriate of ammonia.	27	43	29	4	51	71	70	83	378	368	359
Chlorine and bleaching powder	—	6	17	14	8	2	2	2	51	50	48
Sulphur recovery	—	3	—	—	7	5	3	7	25	19	22
Salt	—	7	38	—	—	8	—	—	53	51	60
Cement	2	14	—	1	3	8	11	54	93	95	95
Alkali waste	—	2	2	7	1	2	1	—	15	16	—
Barium and strontium	—	2	—	—	—	—	—	—	2	2	—
Antimony sulphide	—	—	—	—	—	—	—	3	3	3	—
Bisulphide of carbon	—	—	—	1	2	—	—	2	5	5	—
Venetian red	—	3	2	—	—	4	4	3	16	15	—
Lead deposit	—	—	—	1	—	—	1	—	2	2	—
Arsenic	—	—	—	—	7	—	36	1	44	41	—
Nitrate and chloride of iron	—	—	—	—	45	7	—	—	52	48	—
Muriatic acid	—	—	—	—	11	7	1	8	27	28	23

SEPARATE PROCESSES OF MANUFACTURE—*continued.*

—	Dist. I.—Ireland.	Dist. II.—North of England.	Dist. III.—Cheshire, N. Wales, and Part of Lancashire.	Sub-Dist.—Widnes.	Dist. IV.—East Lancashire and Part of Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England and South Wales.	Dist. VII.—South-East of England.	Total. 1894.	Total. 1893.	Total. 1892.
Fibre separation	—	—	—	—	33	—	—	—	33	30	7
Tar	9	8	15	—	38	23	10	17	120	118	—
Zinc smelting	—	1	1	—	—	—	7	—	9	9	—
Total	69	165	160	62	326	234	225	279	1,520	1,495	1,225

The number of visits paid by the inspectors to the works is irregular, and depends on the process there carried on, and the usual condition of the work. When there is no apparent need for repeated visits they are made about once a month. Some of the works are, however, only in operation during a portion of the year. Usually, a visit is made the occasion not only of a general inspection but often it is found necessary to make a definite test, or chemical examination of the gases which are passing into the air. A table showing the numbers of such visits and tests made in the several districts is here given.

NUMBER of VISITS to WORKS and TESTS made.

—	Dist. I.—Ireland.	Dist. II.—North of England.	Dist. III.—Cheshire, N. Wales, and Part of Lancashire.	Sub-Dist.—Widnes.	Dist. IV.—East Lancashire and Part of Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England and South Wales.	Dist. VII.—South-East of England.	Total.
Visits	135	619	465	550	874	598	789	962	4,992
Tests	65	417	806	1,344	720	361	637	682	5,032

The kind of examination varies in the different works. In the case of the alkali works there is a limit laid down of the amount of muriatic acid gas which may escape without contravening the provisions of the Act. The amount may be stated either in relation to that being produced at the time, or absolutely in grains per cubic foot of the escaping gases. In sulphuric acid works also a definite limit is fixed. In other cases the provisions of the Act are complied with if the best practicable means have been employed for preventing the escape of noxious gas. It has on previous occasions been pointed out that this last is more binding than the previous provisions, for the amount of acid gas escaping

is usually far within the limits fixed in the Act, but the obligation to use the best practicable means is ever binding. The accompanying table shows the average results of all the inspections made during the year of the various classes of works in the different districts.

TABLE of the AVERAGE AMOUNT of ACID GASES escaping for each DISTRICT.

—	Dist. I.—Ireland.	Dist. II.—North of England.	Dist. III.—Cheshire, N. Wales, and Part of Lancashire.	Sub-Dist.—Widnes.	Dist. IV.—East Lancashire and Part of Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England and South Wales.	Dist. VII.—South-East of England.	Average. 1894.	Average. 1893.	Average. 1892.
Hydrochloric acid in chimney gases. Grains per cubic foot.	0·070	0·132	0·050	0·094	0·066	0·098	0·092	0·115	0·089	0·090	0·093
Hydrochloric acid. Amount escaping compared with that produced. Per cent.	1·070	2·270	1·270	2·400	1·660	2·530	1·135	1·553	1·736	1·716	1·937
Acid gases escaping from the sulphuric acid chambers, given as SO_3. Grains per cubic foot.	1·265	1·490	0·860	1·000	1·170	1·630	1·520	1·190	1·266	1·320	1·284
Acidity of chimneys given as SO_3. Grains per cubic foot.	0·600	0·855	0·670	0·861	0·650	0·417	1·010	0·940	0·750	0·730	0·768
Acidity of gases from manure works, given as SO_3. Grains per cubic foot.	0·260	0·153	0·930	0·560	0·260	0·280	0·290	0·250	0·373	0·298	0·272

The first line gives the amount of hydrochloric acid in the chimney gases expressed in grains per cubic foot, and shows the satisfactory result that the legal limit being 0·2 grain, the actual average is kept down to 0·089 grain, or less than one-half the limit. In the second line the amount of the same acid found to be escaping is expressed in percentage of that produced at the time. For this the legal limit is 5 per cent., but the actual average percentage found is only 1·736 or about one-third the fixed limit. A similar remark applies to the next line in the table. It gives the amount of sulphuric acid escaping from the apparatus of manufacture. Of this the legal limit is 4 grains per cubic foot, while the limit actually kept on the average of all the works throughout the year has been 1·266 grain, again about one-third the legal margin. In the fourth line of the table are given the figures which indicate the total acidity of the chimney gases arising from any cause. The principal cause of such acidity in the various classes of works here dealt with is now the sulphur in the coal burnt. In all these works large quantities of coal are used, and this is often of a sulphurous kind. Formerly hydro-

chloric and sulphuric acids were those which gave the potency to such factory smoke, but these have been in the main suppressed, the sulphurous acid however remains, being generated, as intimated, by the combustion of the sulphur in the coal. The numbers in the last line of the table indicate the condition of the chemical manure works as measured by the amount of acid gases discharged from the process after they have passed through the settling chambers and wash towers arranged for arresting them. The amount of such acid is expressed in terms of sulphuric anhydride (SO_3) grains per cubic foot.

It may, perhaps, be said of those acid gases to which reference has now been made, that is sulphuric, sulphurous, hydrochloric, &c., that when the amounts emitted are very small they are no longer actively noxious. Certainly that is so as regards their action on animals, but there are other gases to which no margin of safety can be assigned, and foremost among these is sulphuretted hydrogen. This is a gas very frequently met with in chemical works, but no quarter can be given to it. The inspector demands its total arrest, and fortunately there are many ways in which this may be effected. It does not appear in the last line of the preceding table, which shows the average amount of acid gases escaping, because we are not satisfied if any of it escapes. In small quantities it is unpleasant and unhealthy, in larger quantities it proves rapidly fatal to those under its influence. It is largely generated in the manufacture of sulphate of ammonia, in the distillation of coal tar, in the Chance-Claus process for the recovery of sulphur from the tank waste of the soda works, and from many of the minor chemical manufactures.

Prosecutions under the Alkali Act.

Firm.	Address.	Description of Work.	Nature of Offence.	Penalty.
W. H. Goulding -	Cork, Ireland -	Chemical manure.	Escape of acid gases from manure mixing.	5*l.* and costs.
J. Hutchison & Co. -	Bolton, Lancashire	Tar - -	Non-registration of works.	10*l.* and costs.
Little Island Chemical Company.	Cork, Ireland -	Tar - -	Non-registration -	15*l.* and costs.
Mitcham and Wimbledon District Gas Light Company.	Mitcham, Surrey -	Ammonium sulphate.	Obstruction, section 17	10*l.*
Richmond Gas Company.	Mortlake, Surrey	Ammonium sulphate.	Obstruction, section 17	10*l.*
Southport Corporation	Southport, Lancashire.	Ammonium sulphate.	Escape of sulphuretted hydrogen.	—
The Excelsior Carbonising Company.	Dewsbury, Yorkshire.	Fibre separation.	Non-registration -	10*l.*

This list, though slightly longer than has been usual, is still a small one, and only two of the cases named are for emitting an excess of a noxious gas. Three are for non-registration of works, and two are on account of a contravention of section 17, Alkali Act. This is the first time a charge of that kind has been brought. It is provided in section 17 that all necessary facilities shall be afforded for the due entry into and examination of registered

works, and of the apparatus used for carrying on the processes of manufacture. A penalty is attached to the offence of obstructing an inspector in the execution of his duty. In both cases, here referred to, the inspector was informed that the sulphuretted hydrogen generated in the manufacture of sulphate of ammonia was brought, as is usual in works of this kind, to an oxide of iron purifier. Thereby coming in contact with the oxide of iron, the sulphuretted hydrogen is decomposed, the hydrogen being oxidised, and the sulphur retained as in a filter; the residual inert gas passing away into the atmosphere purified. As the inspector was distinctly informed that all the sulphuretted hydrogen was thus dealt with, he from time to time examined the purifier, and finding that no sulphuretted hydrogen escaped from it, and that it seemed to be in perfect condition, was satisfied until some trifling circumstance raised a suspicion that a secret road had been provided for the noxious gas in question, and that in reality it was conveyed to the chimney, and thus thrown into the air. After some inquiry this, in both places, was found to be the case, the motive on the part of the manager being to save the expense which attends the periodical renewal of the oxide of iron in the purifier. It was doubtless contended that the sulphuretted hydrogen was burnt in the chimney, and so rendered harmless, but of that the inspector was ignorant, not having examined it, as he had been assured that the gas was led in another direction. The important point was that there was a secret pipe buried in the ground, the presence of which was denied, and thus the inspector was "obstructed" from examining the effluent gases as was his duty. On representing these facts to your honourable Board, sanction was granted to my instituting a prosecution against the two gas companies or their managers.

As these prosecutions are conducted in the county courts, application for the penalty is first made as for a debt. In both these cases the amount of the penalty was immediately paid so as to stay all proceedings and avoid publicity. It is much to be regretted that in these two cases there should have been introduced a spirit so much at variance with the open-handed confidence that has generally been maintained between the inspectors and the manufacturers.

Alkali Works.

The Leblanc soda works still hold their own against those of the ammonia-soda process by virtue of the bleaching powder which only they can produce. Efforts are still made to utilise for it the chlorine of the salt decomposed in the ammonia process, but as yet they have not been largely successful. All departments of manufacture suffered greatly during the coal strike of 1893, and from this the alkali trade did not escape. Expensive fuel, and a diminished demand for soda, owing to the contraction of other industries, has kept the trade in a condition of depression from which it is but slowly recovering. The following table shows the

production during the three last years, and gives means of comparing the relative activity under the Leblanc and the ammonia-soda processes. The figures given show the amount of salt decomposed, as that covers the various products of the industry; namely, soda ash, caustic soda, soda crystals, and bleaching powder. It will be seen that, although the total consumption of salt has diminished year by year, yet the extent of the ammonia-soda industry has increased.

SALT DECOMPOSED in the LEBLANC and AMMONIA-SODA PROCESSES (including Scotland).

	1894.	1893.	1892.
	Tons.	Tons.	Tons.
Leblanc process	434,298	467,562	519,593
Ammonia-soda	361,603	349,609	304,897
Total	795,901	817,171	824,490

Great efforts are now made to supersede both the Leblanc and the ammonia process in the production of soda by the use of electricity. The direct action of electricity in the decomposition of common salt has much to recommend it to the manufacturer. The molecules of chlorine and sodium, which together form the molecule of chloride of sodium, or common salt, are rent asunder by electrolysis, chlorine and sodium being produced. The sodium in contact with water immediately forms caustic soda, and the chlorine, absorbed in lime, bleaching powder—the two principal products of the Leblanc soda process. Enticing as the simplicity of this result appears, it is, however, only reached by a journey of many stages if we trace the course of the energy which originates with the coal consumed. In this case coal is burnt to cause the heat which generates steam to move the engine, which works the dynamo to excite the electricity, which, passing through the brine, liberates the sodium and chlorine. This is a chain of many links, at each of which there is great leakage of energy, so that the final result bears but a weak relation to the force originally put forth. Where electricity can be generated cheaply by the use of water power, it will doubtless be a more formidable competitor with the chemical processes, but looking at the many points of leakage of energy where electricity is generated by the steam engine, it would appear that the present chemical methods are not seriously threatened. Should the time ever arrive when coal can be used directly to form, as zinc now does, the positive element in a galvanic battery, then probably a great change would come over our chemical manufactures.

There are three electrical processes for the manufacture of soda now on their trial commercially, or for which works are shortly

to be erected. One of these is by Mr. Castner, of Oldbury. It has been at work for about six months. He employs no diaphragm to separate the soda as generated in the brine, but a thin layer of mercury, in the position of cathode, takes up the sodium as it is liberated, and flows away with it to another compartment of the apparatus, where, coming in contact with water, it is discharged as a solution of soda, the mercury returning to repeat the operation. Compared to the soda produced, the quantity of mercury employed is large, and may perhaps be a heavy element of expense. Mr. Jackson, in his report on District V., in the Appendix to this, gives a somewhat detailed account of the apparatus. *See* p. 66 of this report.

A second process is that of Mr. Vautin. This has been tried for a short time on a small manufacturing scale at the alkali works of Messrs. Harrison, Blair, & Co., Kearsley, but the operations are for the present suspended. In this arrangement fused salt is employed. It lies on a mass of melted lead, which forms the cathode, the anode being a bar of carbon immersed in the fused salt. The lead absorbs the sodium, forming an alloy which, drawn off from time to time, can be utilised in various ways. The chlorine rises from the layer of fused salt, and is led away for absorption in lime, &c.

The third method of applying electricity for the decomposition of salt is brought forward by Messrs. Holland and Richardson. Here the soda solution formed about the iron cathode lying at the bottom of a trough of brine flows away to be boiled down and separated by concentration from the undecomposed salt which accompanies it. The chlorine rises, and is conveyed away for absorption in lime or otherwise. Works for carrying out this process are being erected at St. Helens, Lancashire, by the Electro-Chemical Company. They expect to operate on 50 or 60 tons of salt weekly, and to produce 40 tons caustic soda and 80 tons bleaching powder.

Sulphate of Ammonia.

As in former years I have been able to collect information respecting the amount of sulphate of ammonia made throughout the kingdom. The figures are in the accompanying table, and show the four principal sources from which it is obtained. Ammonia is not a manufactured article, all we have is saved a a bye-product that at one time was wasted. A large quantity is wasted still, not being collected, or is destroyed by the method of combustion. In a former report under the Alkali Act, by the late Dr. Angus Smith, he showed that the uncollected ammonia from coke ovens alone in this country amounted in value to 2,340,000*l.* If to this be added the amount lost by our wasteful system of coal burning generally, both in household fires and in factories, the amount would be very great. Dr. Angus Smith puts it at 50,000,000*l.*

AMOUNT OF SULPHATE OF AMMONIA PRODUCED IN THE UNITED KINGDOM.

	1894.	1893.	1892.
	Tons.	Tons.	Tons.
Gas works	113,634	112,179	110,748
Iron works	10,075	8,833	11,000
Shale works	32,891	28,485	23,105
Coke and carbonising works	3,448	3,265	4,973
Total	160,048	152,762	149,826

It is satisfactory to see in the table signs of continued increase and to know that the value of the sulphate of ammonia now saved reaches the large amount of 2,000,000*l.* sterling, and thus forms an addition to our national wealth.

A controversy has not unfrequently arisen as to the best method of treating the sulphuretted hydrogen arising from the manufacture of sulphate of ammonia from gas liquor. Undoubtedly the best way of dealing with it, when in sufficient quantity, and generated by a continuous arrangement, is to burn it, so that the resulting sulphurous acid and steam pass into a sulphuric acid chamber, and are there used in the manufacture.

Where there is no opportunity for this, and the quantity of sulphuretted hydrogen is large, the Claus kiln affords a suitable and economical method of dealing with it. By this means a large quantity of sulphur that otherwise would have been sent into the air as a noxious gas, is collected in a marketable form. In passing I would suggest to future constructors of this form of apparatus, that the chamber for collecting the sulphur should be of sheet lead supported on a wooden framework similar to that of a sulphuric acid chamber. Those constructed of brickwork soon show signs of injury from the action of the acid gases which condense in them, saturating the mortar and the bricks. If it be feared that the heat close to the kiln would be too great for the lead, a protection might be furnished by a small amount of brickwork inside the lead chamber, or the heat of the gases might be diminished by lengthening the iron flue-pipe which connects the kiln with the collecting chamber.

Where the amount of sulphuretted hydrogen is too small to warrant the use of a Claus kiln, then absorption in oxide of iron should be adopted. If arrangements are made for admitting air to the oxide, either while at work, or in intervals between the periods of working, the oxide may be kept active until it is completely charged with sulphur.

It is only where the amount of sulphuretted hydrogen is very small, as in a village gaswork, that it is admissible to burn it. In such a case it should be brought under the bars of the boiler fire which works in connexion with this process, and so be allowed to pass up through the fire. The use of a special fire constructed for the purpose of burning the gas should be discouraged, as there is no guarantee that such a fire will always be kept in action. The mere passing of the gases over a fire can never be considered satisfactory.

In the 19th annual report under the Alkali Act, the late Dr. Angus Smith has laid it down as a rule to be observed in future, that sulphuretted hydrogen should not be burnt so that the sulphurous acid formed passed away with the gases of a chimney, if by so doing the acidity of those gases were raised to a point exceeding the equivalent of 0·5 grain SO_3 per cubic foot. I think this rule is a good one, and should be maintained. It is true that in the process for the recovery of sulphur from the tank waste of the alkali works, the gases from the Claus kilns raise the acidity of some of the chimneys above this limit, but it is to be hoped that some improvement will be introduced here, and the waste of sulphur restrained. The temporary excess has been accepted as the lesser of two evils, for otherwise there would be an escape of sulphuretted hydrogen which certainly would be worse.

In order to show the various methods now adopted throughout the country for dealing with the sulphuretted hydrogen resulting from the manipulation of the ammoniacal liquor from gas, iron, and shale works the adjoining table has been prepared. In some cases the gases are passed through water containing lime and sulphate of iron in suspension. This method is useful where, as a precaution against fire, it is desired to trap the gases. In some other cases the gases pass through arsenical sulphuric acid, so that a double end is attained; firstly, the sulphuretted hydrogen is taken up by the arsenic acid, and, secondly, the acid is purified by the removal of the arsenic as sulphide. In some of the smaller sulphate of ammonia works the sulphuretted hydrogen is burnt by passing up through the boiler fire. This is done chiefly in the South of England at small gas-works. The whole amount of work done at some of these places is so small that the sulphurous acid thus passed into the chimney is not noticeable. At the iron and shale works the liquor contains so small a quantity of sulphur that, even in places where oxide purifiers have been provided, it has not been found necessary to maintain them. The following columns explain themselves. The words "intermittent" and "continuous" refer to the sulphate of ammonia apparatus. It will be noticed that in the extensive works of the North of England, the continuous system largely prevails. When the process is conducted uniformly and the sulphuretted hydrogen comes off in unbroken stream, a much smaller oxide purifier will suffice than is necessary when, under the intermittent system, nearly all the gas comes off in a short time.

Methods of Treating the Sulphuretted Hydrogen evolved in the manufacture of Ammonium Sulphate, &c. from Gas Liquor.

District.	Precipitation by		Burnt. The SO_2 passed into Air.			Burnt. The SO_2 passed into O. V. Chambers.	Burnt in Claus Kilns.	Decomposed in Oxide of Iron Purifiers.		Decomposed in Lime Purifiers.		Passed into the Hydraulic Main of Gas Works.	Total.
	Milk of Lime and Copperas.	Arsenic in Purification of Oil of Vitriol.	Gas Works.	Iron Works.	Shale Works.			Intermittent.	Continuous.	Intermittent.	Continuous.		
Scotland	2	—	9	10	13	—	—	12	8	—	—	—	54
District I.—Ireland	—	—	11	—	—	—	—	7	9	—	—	—	27
District II.—North of England.	—	2	8	—	—	2	3	2	26	—	—	—	43
District III.—Cheshire, North Wales, and part of Lancashire.	—	—	9	—	—	—	1	1	17	—	—	—	28
Sub-District.—Widnes	—	—	—	—	—	—	—	1	3	—	—	—	4
District IV.—East Lancashire and part of Yorkshire.	—	—	2	—	—	7	6	8	27	12	6	—	68
District V.—Midland	—	—	1	—	—	9	5	14	34	—	3		67
District VI.—South-west of England	—	—	11	—	—	—	2	35	22	—	—	—	70
District VII.—South-east of England.	—	—	20	—	—	5	7	26	24	—	—	—	82
Total	2	2	71	10	13	23	24	106	170	12	9	1	443

Tank Waste.

The treatment of the tank waste of the alkali works by the Chance-Claus process is still carried on successfully. All the waste at Widnes, St. Helens, Oldbury, and some other places, is now treated so that in these there is no raw waste deposited on the land as formerly. The old waste, however, still remains, and the drainage from it continues to give trouble.

A fatal accident occurred recently at Irvine, in Scotland, from a quantity of muriatic acid having leaked from a tank on to a mass of waste which had been used as a foundation for it.

Tank waste has frequently been used for filling up hollow places in chemical works, and it becomes soon hard enough to be trusted for building on. It should, however, be a rule never to use it under or near to acid tanks or condensers. In this case a plumber, when engaged in repairing the pipes leading to an acid tank, which had been built on a bed of waste, was overcome by sulphuretted hydrogen generated by the acid which leaked out. He succumbed to the effects and did not recover, although the work was being carried on in the open air.

Nitric Acid Works.

Of late years a greatly increased demand has sprung up for nitric acid, owing to the development of the manufacture of nitro-glycerine, guncotton, and other nitro explosives. Mr. Oscar Guttman has introduced a system of condensing the acid in a series of small stoneware pipes, a much more compact apparatus than the Woulff jars and connecting bends formerly used; they are still employed where the manufacture is not extensive.

Mr. Manning Prentice, of Stowmarket, has further developed his continuous still, and constructed one of larger size. The nitre and sulphuric acid are fed in continuously, and the operation goes on without break. Here, as in other continuous work, the great advantage is realised of avoiding the otherwise necessary cooling and reheating of the apparatus, entailing beside a loss of fuel and material, a liability to leakage from the alternate expansion and contraction of the joints.

Tar Works.

I am glad to be able to report that nearly all the tar-distilling works throughout the kingdom have now been brought into conformity with the requirements of the Alkali Act. Most of them needed some alteration, especially in regard to two points of the manufacture. Firstly, the gases which escaped uncondensed from the ends of the still worms required control. These were mostly hydrocarbon gases mixed with much sulphuretted hydrogen, the exact composition varying with the condition of the distilling operation. These highly offensive gases used to escape freely into the air and were a principal cause of the nuisance so often

complained of. Now, by means of a swan neck attached to the end of the worm, or of a gas-tight box, these gases are retained and led away in an iron pipe to some convenient fire and burnt. If brought to the boiler fire, an important addition to the fuel is gained, as a large tongue of flame issues from the pipe and is of material assistance in keeping up the steam. If the last portion of the pipe, that nearest the fire, is small, the flame will not travel back, yet, for greater safety, it is thought desirable to introduce a water seal in the course of the pipe. Some of the tar distillers have preferred an absorption arrangement to that of burning. To this end the gases pass through a receiver containing heavy oil. This absorbs the hydrocarbon gases, and the sulphuretted hydrogen may be separated either by lime or oxide of iron. The removal of these gases from the air of the works has caused a great improvement, one which the workmen freely acknowledge, hardened though they appear to be against any attack on their olfactory nerves.

The second place where additional care appeared necessary was the pitch bay. After the removal by distillation of the more volatile constituents of the tar, the residual pitch has attained a very high temperature, and if in this state it is allowed to flow out into the pitch bay provided for it, the air is filled with a pungent vapour that may cause great nuisance throughout the neighbourhood. Where the operations of the factory were not pressed and carried on at full speed, the pitch was often allowed to remain in the still till partly cooled before it was drawn off, but this could not always be done, a safer precaution has been to place an intermediate vessel between the still and the bay, here the pitch remains until it is so far cooled as to be barely fluid enough to flow out of the holder. In some exceptional cases, where the relative levels of the tar stills and the pitch bay will not allow of the use of an intermediate vessel, the hot pitch is allowed to flow through long covered iron troughs or through pipes jacketed with a current of cold water so as to be cooled before exposure to the open air.

Some minor precautions are also taken against the escape of noxious gases from other portions of these works whence annoyance often arose. In particular may be mentioned the ventilation of store tanks for holding tar, gas liquor, &c. When these large receptacles are filled with liquor, a volume of air of equal volume to the material brought in must be driven out. This air is saturated with offensive vapour and is likely to cause considerable nuisance unless it is passed through some purifying apparatus. The rule is now that all apertures to these tanks are closed except the one outlet pipe through which the outflowing gases must pass, and by it be led to a bed of oxide of iron or lime, &c., so as to absorb the sulphuretted hydrogen, or ammonium sulphide which it probably contains. It is satisfactory to know that since the general adoption of these precautions, the pollution of the air in the neighbourhood of many tar works has materially diminished.

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Felt Works.

This class of works, the most important of which are situated at Belfast, first came under inspection in 1892, as works in which tar is heated. In my annual report for 1892 attention is drawn to the grave nuisance in this class of works which arises from the melting of pitch, &c., in open pots, and the subsequent treating of felt by the hot material. During the past year these works have been under careful inspection, and a special report has been forwarded by Mr. Ballard, embodying the results of his observations, and suggesting precautions that should be taken for the better control and regulation of the processes therein carried on.

There are two operations in the manufacture of felt that call for special attention and care on the part of the manufacturer. In the first of these pitch, mixed with creosote, raw or refined tar, is melted in iron pots. From this it is taken for use in a second operation where the felt is saturated with the melted material on its passage between heated rollers dipping in a tank of the mixture. There are various methods employed for softening the pitch used for this purpose. Some manufacturers heat the pots by a fire placed below them, as this enables the work to be pressed forward in cases of emergency; others prefer to use steam-jacketed pots, and carry on the work more slowly and regularly, with less wear and tear. The escape also of pungent fumes through overheating of the material is thus diminished and there is less risk of serious fires, such as have occurred in several instances through an undue pushing of the process. It is possible, moreover, by somewhat increasing the number of the steam-jacketed pots to meet any extra demand upon the output.

It is a matter of experience that creosote gives off more fumes than do the other softening agents during the process of melting, but it has the advantage over both raw and refined tar in that it hastens the melting of the mass and produces a more fluid material; on this account its use is preferred by some manufacturers, as it enables them to work more rapidly and the tar has greater power of penetrating the felt in the machines. On the other hand, it must be remembered that the fumes given off during the process are much more distressing when creosote is employed. Some manufacturers also assert that the more flexible and durable qualities of felt are obtained by the use of refined tar as a softening agent, and that it is advisable to prevent the tar from sinking too deep into the felt by working with the rollers at as low a temperature as practicable. However, whatever method of softening the pitch be employed, fumes are invariably given off in greater or less quantity, and it is imperative therefore that all melting pots should be provided with a cover draughted by fan or steam-jet to a suitable condenser. Mr. Ballard proposes a conical cover, provided with a circular gutter inside, to collect the moisture that is given off during the earlier stages of the operation, and which is liable to cause serious frothing if not

removed. The melted tar could be withdrawn through a circular hole, 18 ins. in diameter, by a ladle, the hole being closed when not in use; or a better plan would be to have a tap below heated by steam, through which the tar could be run direct into iron buckets as required.

During the process of saturating the sheet of felt with tar very pungent and irritating fumes are given off, and pass directly into the air of the closed workroom in which many women and lads are employed. The air of the place speedily becomes charged with tar vapour to such an extent as to be highly injurious to the operatives. To confine this vapour is a matter of great difficulty, as it is absolutely necessary that the workmen should be able to keep a close watch on the endless sheet of felt as it travels through the machine, so that they may be able to remove any foreign material that may be entangled in it. The use, therefore, of a closely fitting hood or cover is impracticable. It is possible, however, to collect the fumes given off when the tar comes in contact with the heated rollers by means of an iron hood placed a few feet above the machine, and draughted to a suitable condenser by a fan. An alternative plan is to place a fan in the roof of the building, and thus withdraw the pungent vapour as it ascends, before it has time to cool and fall.

Mr. Ballard suggests that the adoption of the following precautions, based on methods in actual use at felt works in Belfast, would tend to the removal in great part of the grave and distressing evils hitherto associated with this manufacture.

Melting Pots.

(1.) The pots in which the mixture of pitch and tar is melted should be steam-jacketed and fitted with a cover in connexion with a 9-inch flue through which the fumes given off during the operation are draughted by fan or chimney. Two forms of cover are suggested as meeting all the requirements of the case. The first is conical in shape, with a curved lip on the inside edge to collect and remove any moisture that may be given off. It is provided with a suitable working door which is kept closed when not in use. The second form is flat. It is hinged in the centre, and contains a circular hole 18 inches in diameter, through which the melted pitch can be withdrawn by a 12-inch ladle. This working hole is closed, when not in use, by a light cover provided with a handle. But it is preferable that all pots should have a tap, heated by steam, through which the melted material can be run off from the bottom as required.

(2.) Not less than six 2-ton pots should be provided for supplying two machines.

(3.) Refined tar should always be employed for softening the pitch in preference to creosote or raw tar when possible.

Machines.

(1.) Large hoods should be placed about six feet above each machine by means of which the fumes may be collected and withdrawn through a horizontal low level flue by fan or chimney draught. In this way all connexion between the machines and roof of the building is avoided. Or a ventilating fan should be placed in the roof of the building to withdraw the hot fumes as they ascend.

(2.) The temperature of the rollers should be kept as low as practicable.

Coal Smoke.

The consideration of ordinary coal smoke is not a duty imposed on the inspectors under the Alkali Act, yet as they are constantly called to examine the gases of chimneys, and as common coal smoke is one of these, it cannot escape their attention. It becomes, indeed, often necessary that they should take cognisance of it, seeing that it is frequently the cause of that injury to vegetation which is too often ascribed to the action of the gases which may escape from processes of chemical manufacture. This is markedly the case in Widnes. There, if we include the few neighbouring works on the Cheshire side of the Mersey, about one million tons of very sulphurous coal are annually consumed in the various factories. This coal contains about 1½ per cent. of volatile sulphur, an amount equal therefore to 15,000 tons sulphur, and generating 30,000 tons sulphurous acid, which is distributed over the country. It happens that Widnes covers a narrow strip of land which may be roughly described as of about 1½ miles in length and ⅓ mile in breadth. Lengthways this land lies east and west, with Ditton, a farming district, at its western boundary. It seems, therefore, inevitable that in the Spring, when the young vegetation is tender, and we may have a prevalence of east wind, that the plants there will suffer from the torrent of acid coal smoke which passes over them, enfeebled as they are by the coldness of the wind from that quarter. Some have boldly proposed to wash all factory smoke, bringing it by dash wheels into contact with lime and water in a spray chamber, and supplying the draught of the chimney thus destroyed by mechanical means. It is easy to see that the cost of this would be prohibitive; even the water required would be an expensive item.

In speaking of coal smoke, however, the black carbonaceous portion is that which is mainly referred to. It is that which pollutes the outside and inside of our dwellings and obscures the light in our crowded towns. With a view to assist in ascertaining which, if any, of the numerous mechanical and other appliances were successful in preventing the production of black smoke, while maintaining or increasing the efficiency of the furnace, an association of manufacturers was formed in Manchester a few

years ago.* Their report, though much delayed, is shortly to be expected. It is understood, however, that this will show abundantly that means now exist for preventing the discharge of black smoke without any sacrifice of economy, and that by the use of good automatic stokers, a saving is effected as compared with intermittent hand-firing, in that a cheaper coal can thus be employed with equal efficiency.

It is doubtless true, however, that in some cases intermittent firing is necessary, for often the demand on the fire is irregular, as in certain chemical and other works. This gives colour to the assertion that therefore the production of black smoke is inevitable. That these cases are more difficult to control than those where, like the steam boilers of cotton mills, the greatest regularity is maintained, is true, but the word *impossible* need not be used. As every such abnormal case must be considered separately, it is impossible to discuss them here, but it may be asserted that by the exercise of due care as to the admission of air and its mixture with the unburned gases, and the maintaining the temperature of that mixture sufficiently, all inflammable matter in the gases may be burnt. As to the fallacy that when by such means the black portion of the smoke has been burnt, yet the poisonous gas, carbon monoxide, may remain unconsumed, I would refer to my annual report for 1892, p. 38, where many actual analyses of chimney gases are given. In none of those which are free from black smoke could carbon monoxide be found, though it was found in some of those in which dense black smoke was present.

In view of this it may be said that it is in the power, and it is therefore the duty of manufacturers, to conduct the necessary combustion of coals in the various furnaces of their works so as to avoid the discharge of black smoke into the air. To thus pollute the air is an offence under the Public Health Act, 1875 and is therefore within the control of magistrates having the administration of the law.

Open House Fires.

Although I believe it may truly be asserted that where coals are thus burnt in close furnaces there need be no visible smoke, and that factory chimneys may be kept clear, yet as much cannot be said of the domestic open hearth, with the cheerful blazing fire an Englishman loves so much. Something may perhaps be done to mitigate it in kitcheners and other close stoves, but the open fire is, I fear, incorrigible. Still I think there is a door open through which relief may come. I would not seek to alter the present open grate, nor forbid its use, but steps may be taken, perhaps, to render its use less frequent, and at the same time increase the comfort of the house. An attempt should, I think, be made to afford a liberal supply of warm air, not merely

* Mr. Fred Scott, 33, Brazenose Street, Manchester, is Secretary.

to provide hot pipes, stoves, &c., but warmed *fresh* air. The object of our fires is to warm the air of the rooms. This now is done by the radient heat of the fire first warming the walls or furniture, then they in turn warm the air. But while doing this the open fire is sending up the chimney a rapid stream of air drawn from the room, which air must be replaced by the cold air from without. It enters by the crevices round doors and windows, causing chilly draughts, so that the temperature in different parts of the room varies much, indeed, a person near the fire may be unpleasantly scorched on one side, yet chilled by cold air on the other. My suggestion is, and I speak after long experience of the system, to place a stove in the basement, and to send a liberal supply of warmed air into the centre of the house. The fresh air should be brought by a pipe from the outside, and preferably filtered through a large blanket or sheet of cotton wool before reaching the stove. Then, all dust being removed, no parched or burnt smell is imparted to the air. Burnt air is a misnomer, it is the small fragments of wool, hair, and organic matter, suspended as dust in the air, which are charred and burnt, and thus impart the characteristic odour. If a copious stream of filtered fresh warm air be supplied from below into the centre of the house, it follows the passages, passes into all the rooms, and ultimately escapes by the chimneys and window crevices, thus quite preventing the draughts of cold air previously sucked into the house, and that most objectionable down draught of the disused chimneys. The futile attempts to warm houses by means of open fires is made apparent when really cold weather visits us. I lately heard of one house, inhabited by a large family, where recently during a week of frosty weather 21 open fires and 5 oil or gas stoves were kept burning. In this case, of course each fire, though emitting a certain quantity of radiant heat, went far to neutralising this by the indraught of cold air necessarily drawn into the house to supply the currents sent up the open chimneys. There is no doubt that one of these 21 fires burnt in a properly arranged stove would have heated the whole house more effectually than did the whole 21 as described. In a house, the general atmosphere of which is maintained at a temperature of 55° or 60° Fahrenheit by such a stove, the fires may be lighted, but they will receive little attention, and, except in the coldest weather, will not be used at all. In this manner I think the consumption of coal would be greatly diminished, and the smoke and smuts of our town air in large measure removed. Certainly the comfort of a house so warmed is much greater than one warmed only by open fires, and the coal bill is much less. In a London house, of which I speak from experience, the cost of coke or anthacite coal burnt in the stove which warmed the whole, was only 3*l.* during the winter, while in neighbouring houses of the same size the coal bill was not less than 25*l.* There was also the advantage of breathing pure filtered air, free from the dust, fog, and smuts which prevailed outside, and also the pleasure of knowing that no smoke was sent away to diminish the comfort of

other people. In the house I refer to, no coal was kept in the house for five or six years. Coke or anthracite was used in the stove, the cooking, and extra warming in some of the rooms, was done by gas. I believe this is a practical suggestion, which, if carried out, would greatly diminish the smoke of large towns, and add to the comfort and health of the people.

Testing Chimney and other Gases.

The principal acid found in the smoke from furnaces where coal is burnt is sulphurous acid, and the same is the case in the gases discharged at the exit pipes of sulphuric acid chambers. In order to test the acidity of these gases, it is usual to bring a measured quantity into intimate contact with a standard solution of carbonate of soda. This is commonly done by placing the alkaline solution in the collapsing aspirator and shaking it with the gas. If the quantity of air in the gas is large compared with that of the sulphurous acid, and time enough be given, the sodium sulphite first formed may be entirely converted into sulphate. The surplus alkali can then be determined by standard solution of sulphuric acid in the usual way, using litmus or methyl-orange as indicator. If, however, the amount of sulphurous acid is relatively large, so that some sodium sulphite remain in the solution, then methyl-orange can no longer be used as an indicator, unless by the addition of hydrogen peroxide, or other oxidising agent, the sulphite has been oxidised to sulphate.

The reason is seen on noticing that when a solution of H_2SO_4 is added to one of Na_2CO_3 we have a formation of Na_2SO_4, and that, on further addition of H_2SO_4, $NaHSO_4$ is formed. This acid salt acts on methyl-orange giving the characteristic tint of colour. If on the other hand there be Na_2SO_3 present in the solution, Na_2SO_4 and $NaHSO_3$ will be formed on addition of excess of H_2SO_4, and this produces no change in the colour of the methyl-orange.

As a proof of this, the following laboratory experiments were made :—

Of a solution of sulphurous acid in water 13 c.c. were taken and further diluted with 100 c.c. water. To this was added peroxide of hydrogen. On addition of a standard solution of sodium carbonate, 2·86 c.c. were necessary to make it neutral as indicated by methyl-orange. The same quantity of sulphurous acid without the use of the hydrogen peroxide required 1·68 c.c. of the same alkaline solution. This would in the first experiment be equivalent to 0·0358 grains SO_3, whereas in the second experiment sodium carbonate equivalent to 0·020 grains SO_3 was required. Determining the same quantity of sulphurous acid solution by iodine the equivalent of 0·0356 grains SO_3 was found. It is obvious, therefore, that the use of peroxide of hydrogen or an equivalent oxidising agent is necessary.

Health of Workpeople.

The following note relating to the health of men employed in chemical works will be received with interest. It is from "Die Chemische Industrie," 15th January, 1895:—

"Statistics communicated concerning the condition of health of the workmen employed by the Griesheim Chemical Company in Germany, published for 10 years past by Dr. C. Wolff (Medical Officer to the works) in his annual report on that subject.

"These reports refer to the health of the workmen employed in the manufacture of sulphuric acid, hydrochloric acid, nitric acid, soda-ash, caustic soda, nitrobenzone, picric acid, chromates, &c.

"The number of days during which the men are ill is compared with former times, and the rate is a little higher. This is explained by the influenza epidemic, and from the circumstance that the rules of the sick clubs have been altered in such a way that instead of paying sick benefit for a quarter only it is now given for half a year.

"Formerly, patients suffering from chronic diseases could only draw money for 91 days, now, owing to the alteration in the law they benefit for 182 days. *As in previous years, it has been found that artisans, such as carpenters, coopers, joiners, slaters smiths, &c., show a higher percentage of sickness than the process men.*"

In the Appendix to this will be found reports from the inspectors on the work done in their respective districts. It will be seen on perusing them how necessary are their continued and unexpected visits to the various chemical works. The present condition of the works in general, and the manifest and increasing care that is bestowed on their management may be traced in great measure to the inspectors' frequent visits. The candid relation that has always prevailed between the manufacturers and the inspectors is still maintained, and the wholesome rivalry between works of the same class as to their standing under the Alkali Act continues as an incentive to progress.

I have the honour to be,
My Lords and Gentlemen,
Your most obedient Servant,
Alfred E. Fletcher.

March 1, 1895.

District No. 1.—Ireland.

Edward Geo. Ballard, Esq., *Inspector.*

During the year 1894 the following works have been registered in the district:—

2	alkali works.
11	sulphuric acid works.
6	chemical manure works.
25	sulphate of ammonia works.
2	cement works.
6	tar works.
Total - -	52

The number of separate processes carried on at the above works coming under inspection are given below :—

2	alkali manufacture.
12	sulphuric acid manufacture.
17	chemical manure manufacture.
27	sulphate of ammonia manufacture.
2	cement manufacture.
9	tar distillation and felt manufacture.
Total -	69

Number of visits paid, 135; tests made, 65.

Alkali Works.

Of the two works registered, one, No. 258, was closed early in the year, and has since been dismantled. At the remaining work, No. 237, they merely roast nitrecake.

Tests have been made at both places, and are as follows :—

No. 258. Total acidity, ·65 grain SO_3 per cubic feet.
Hyrochloric acid, ·09 grain per cubic foot.

No. 237. Total acidity, ·55 grain SO_3 per cubic foot.
Hydrochloric acid, ·05 grain per cubic foot.

At these latter works they also manufacture sulphuric acid.
Total acidity of exit, ·40 grain SO_3 per cubic foot.

The works have been much improved during the year.

Sulphuric Acid Works (including some Manure Works).

These works continue to be carried on in a satisfactory manner; the usual tests have been made, the averages of which are given below. No. 249, although registered as a sulphuric acid work, has not manufactured any during the year.

District No. 1, Ireland—*continued*,

TABLE SHOWING AVERAGE ESCAPE FOR 1894.

Register Number.	Total Acidity as Grains SO_3 per Cubic Foot.	Material used.	Remarks.
No.			
216	—	Brimstone.	Works closed and being pulled down.
221	2·25	Pyrites.	
225	3·40	„	
226	·90	„	
237	—	—	Now registered as an alkali work.
238	·45	„	
245	1·43	„	Works undergoing thorough renovation.
247	1·08	„	More care might be exercised here with respect to low level escapes in the kiln house.
252	·40	„	
255	·55	„	
256	1·79	„	
Average	1·36		

CHEMICAL MANURE WORKS.

There are 17 works of this description in Ireland, six of which are registered as manure works, the remaining 11 being covered by certificates granted for the manufacture of sulphuric acid, &c.

All those where superphosphate is treated are provided with condensers for the noxious vapours evolved. There is room, however, for improvement in some of these.

At one work, No. 255, a very inefficient apparatus has been replaced at considerable expense by a well arranged wash tower condenser, which is answering its purpose well. It is to be hoped that by next report all will be in an equally satisfactory condition. At No. 226 a depositing chamber, between the mixer and towers, has been constructed with much benefit. A similar arrangement has been made at No. 238, in which they say that nearly half the work of condensation is effected before the gases reach the wash tower.

TABLE SHOWING CONDENSATION EFFECTED BY MANURE GAS WASH TOWERS.

Register Number.	Total Acidity as Grains SO_3 per Cubic Foot.			Remarks.
	Inlet to Condenser.	Outlet from Condenser.	Percentage escaping.	
No.				
247	5·46	·25	8·04	Works in good order.
226	3·70	·55	14·04	A depositing chamber has been recently completed reducing the escape to 7·81 per cent., and exit to ·25 gr.

District No. 1, Ireland—*continued.*

TABLE SHOWING CONDENSATION EFFECTED BY MANURE GAS WASH TOWERS—*continued.*

Register Number.	Total Acidity as Grains SO_3 per Cubic Foot.			Remarks.
	Inlet to Condenser.	Outlet from Condenser.	Percentage escaping.	
No.				
255	1·00	·05	5·00	New condenser at work. In good order.
238	9·30	·32	4·35	Works in good order.
225	1·20	·23	21·26	Much neglect displayed at these works in not attending to the water supply on tower.*
221	16·00	·30	1·87	Very good condensing arrangements at these works.
248	1·60	·15	9·37	Works in good order.
Average -	5·46	·26	9·13	

* A prosecution was instituted.

At No. 248 steps are being taken to bring the percentage escape much lower. The tower is a new one, but the gases are driven rather too rapidly through it by means of a fan, before they have time to be decomposed and condensed. The speed is to be reduced and water supply increased.

SULPHATE OF AMMONIA WORKS.

These are carefully conducted. Improvements are being carried out at some of them at my suggestion, but are not yet completed. The works are all in good order.

Taking all the places where they make sulphate of ammonia in Ireland, the number of works with continuous system of distillation = 12.
" " " intermittent " " = 15.
" " absorbing H_2S in oxide purifiers = 16.
" " burning the sulphuretted hydrogen = 11.

2,707 tons of sulphate of ammonia were made in the district during the year.

CEMENT WORKS.

There have been no complaints of nuisance arising from these works, which are well conducted.

TAR WORKS.

At those works where tar is distilled, proper arrangements have been adopted for dealing with the noxious vapours evolved, and are described in last year's reports. There is, however, a class of works registered as tar works, where roofing felt is made. These have needed some study, in order to arrive at a practical method of dealing with the vapours which arise from the machines where the felt is soaked with the melted mixture of pitch and tar, or pitch and creosote oil, the latter causing the sheds to be filled with a most pungent and irritating vapour. In cases where refined tar is employed for softening or "tempering" the pitch, there is a marked difference as to the effect of the vapours on the throat

District No. 1. Ireland—*continued.*

and eyes; here the gases are far less distressing than when creosote oil alone is used. Many experiments as to the temperature to which either of the above mixtures are heated have been made, and they are found to vary from 192° Fahrenheit to 270° Fahrenheit at the machines, and from 212° Fahrenheit to 295° Fahrenheit in the melting pots, where the mixture is heated before being carried to the machines. The following examples will give an idea of the kind of mixture employed for felt manufactures.

A.		B.	
Pitch	= 26 cwt.	Pitch	= 26 cwt.
Refined coal tar	= 250 gallons.	Creosote oil	= 58 gallons.

The proportions of tar and creosote oil, or a mixture of both, to the pitch vary according to the quality of the pitch and other circumstances, for instance, the kind of felt being manufactured at the time, but the above are typical examples of the mixtures employed.

When the felt being manufactured is very thin, such as is used for sheathing ships, it becomes necessary to have the tar and pitch very fluid, or the felt would tear and such a mixture as the following might be employed :—

Pitch	= 20 cwt.
Refined tar	= 60 to 70 gallons.
Creosote oil	= 40 gallons.

Hoods placed over the machines, with a flue passing up through the roof, have been tried, and have proved a most dangerous method of carrying off the vapour, for the reason that should the machine take fire from any cause (and such is often the case), the flame immediately rushes up to the roof, and a serious fire might be the result. However, it has been suggested that the vapours might be carried off by a hood brought out well over the machine, and connected with a horizontal flue provided with an exhaust fan, instead of a vertical one, and thus all communication between the machines and the roof would be avoided. One firm, No. 249, is arranging to try this plan, meantime, the other works are waiting to see the result of the idea. One firm, No. 905, has placed a ventilating fan in the roof of the machine house, which has much improved the atmosphere for the workpeople, and another is about to follow their example. The vapours ascend, but are carried out before they have time to fall again, and thus a good ventilation of the shed is promoted.

With respect to the vapours arising from the melting pots, there is no difficulty in dealing with these. They are most effectually dealt with at No. 249, and condensed. The method consists in simply covering the pots with a lid connected with a flue, as fully described in last year's report, page 36.

There are two methods of heating the melting pots, one by means of a direct fire, the other by steam, the pots being steam jacketed. The overheating of the melting pots is not only a source of danger, but also a source of nuisance and waste, hence the advantage of the steam heated pots over those heated by a direct fire. An excessive amount of creosote oil in the mixture is often merely added to hasten the melting where the number of pots is insufficient to meet the demands of the machines. There should not be less than three 2-ton pots provided for supplying each machine. This is little enough if it is desired to avoid over heating and its accompanying danger and nuisance arising from the pungent vapours given off at such high temperatures. Moreover, where steam-jacketed pots are employed there is no danger from fire, which is another point in their favour, for it sometimes happens that the melted mixture boils over, especially when the pitch is wet from lying out of doors in the rain. It will be seen from what has been said that one step in the right direction would be to provide a sufficient number of pots to each machine, and they should be covered and connected with a flue, the vapours being drawn off by a fan or chimney draught, and in order to avoid over heating they should also be steam jacketed. In one work, No. 904, where the pots are steam heated, the melted mixture is drawn

District No. 1, Ireland—*continued.*

off from below by means of a tap. This seems far preferable to the usual method of dipping out the melted pitch with a ladle, and might be adopted, one would think, with advantage in other works. A special report has been made to the chief inspector upon the felt works generally and suggestions made for the regulation of same, and it is to be hoped that during the coming year they will all be placed on a more satisfactory footing as regards the abatement of the nuisance arising from pungent vapours given off in this manufacture.

Improvements during 1894.

No. 237. Many improvements both in plant and management.
„ 226. Added a depositing chamber to manure gas condensing plant.
„ 255. Constructed a very good new condenser for manure gases.
„ 238. Added a depositing chamber to manure gas condensing plant.
„ 221. Added four more pyrites kilns and constructed an additional O.V. chamber.
„ 905. Ventilated the felt machine shed by means of a fan in the roof.
„ 909. All melting pots for felt manufacture covered and fumes drawn off by a flue.

There are improvements in course of being adopted at some of the Irish works, which are as yet incomplete; they will be given in the next report.

Edward Geo. Ballard,
Inspector.

District No. 2.—England, North.

Bernard E. Smith, Esq., F.I.C., F.C.S., *Inspector.*

The number of works registered under the Alkali, &c. Works Regulation Act, 1881, and the Alkali, &c. Acts Amendment Act, 1892, in this district for year ending December 1894, was 118. These included 14 alkali works and 104 scheduled works.

The number of separate processes under inspection was 165, as under:—

10 alkali.
4 copper extraction.
5 bleaching powder.
1 chlorine.
19 sulphuric acid.
2 Chance-Claus sulphur recovery.
3 Claus sulphur recovery.
3 nitric acid.
43 sulphate of ammonia.
1 gas liquor.
1 liquid ammonia.
38 chemical manure.
7 salt.
14 cement.
8 tar.
3 Venetian red.
1 zinc.
2 barium.

The number of visits made to the various works amounted to 619 and 417 tests were carried out.

District No. 2—*continued.*

ALKALI WORKS.

The number of this class of works registered in the district remains the same as that in 1893. Unfortunately the work has been anything but brisk, in fact, in two of the works no salt has been decomposed.

At one of the works an additional "salt cake" furnace of the Gaskel-Deacon plus-pressure type has been built, and the condensing plant has been amplified by the erection of six coke wash towers, each 48 feet 6 inches high by 6 feet square, inside measurement.

No other plant has been erected. That in existence previous to the commencement of year has been maintained in good and sufficient repair.

The amount of salt decomposed, exclusive of copper works, amounted to 90,963 tons as compared with 99,996 tons in the year 1893. This is a decrease of 9,033 tons or nearly 10 per cent. This decrease is mainly to be accounted for by the fact that, beside two works not having decomposed any whatever, the plant in a third work was laid in after the first three months of the year.

The following table gives the result of tests made during year:—

Registered Number of Works.	Grains HCl per Cubic Foot of Smoke.			Percentage Hydrochloric Escape.	Average Total Acidity of Chimney Gases calculated as Grains SO_3 per Cubic Foot.
	Max.	Min.	Average.		
355	0·16	0·09	0·10	2·75	0·55
374	0·19	0·12	0·16	3·20	0·55
378	—	—	—	—	—
379 I.	0·18	0·11	0·14	1·75	0·55
379 V.	0·16	0·09	0·14	—	0·50
386	—	—	—	—	—
393 I.	—	—	—	—	—
393 II.	0·15	0·12	0·13	2·20	0·50
393 III.	0·09	0·06	0·07	1·00	0·50
405	—	—	—	—	—
407 I.	0·17	0·09	0·15	—	0·50
407 II.	—	—	—	—	—
413	0·14	0·07	0·11	2·00	0·55
458	0·11	0·07	0·10	3·00	0·50
Average for District			0·12	2·27	0·52

Compared with average of previous years:—

	Nine previous years.	1894.
Grains of HCl per cubic foot	0·116	0·12
Percentage HCl escape	2·840	2·27
Average Total Acidity	0·535	0·52

COPPER WORKS (WET PROCESS).

The whole of the four works have been fully employed during the year, with the exception of the smelting departments of one of them. Two additional condensing towers are in course of erection at the works

District No. 2—*continued.*

idle during 1893. These are required to supplement those already erected by reason of the stoppage of the smelting department.

Results of tests during 1894 :—

Register Number of Works.	Grains HCl per Cubic Foot of Smoke.			Average Total Acidity, calculated as Grains SO_3 per Cubic Foot in Chimney Gases.
	Max.	Min.	Average.	
353 I.	0·19	0·09	0·15	1·30
353 II.	0·16	0·07	0·14	1·50
366	0·11	0·10	0·11	0·70
414 I.	0·20	0·14	0·16	1·60
414 II.	0·19	0·14	0·17	1·90
415	0·27	0·14	0·18	1·10
District Average - - -			0·15	1·35

Compared with preceding years :—

	Nine preceding years.	1894.
Grains HCl per cubic foot - - -	0·140	0·150
Average Total Acidity - - -	1·350	1·350

Bleaching Powder Works.

There are five of these works which have been employed more or less actively during the year. There is no change of any importance to report in their condition, and the same care has been exercised in keeping the amount of chlorine allowed to escape when opening doors of chambers for packing powder as low as possible.

No complaint arising from nuisance by escapes of chlorine has been received.

The total amount of chloride of lime (bleaching powder) made during 1894 was 33,433 tons, as against 39,109 tons and 36,000 tons for 1893 and 1892 respectively.

Alkali Waste and Alkali Waste Drainage.

No "alkali waste" has been deposited by any of the works during the year. All that has not been employed in the "Chance-Claus Sulphur Recovery Processes" has been removed, with other refuse, to sea, and there disposed of. Complaint is still frequent, especially after wet or rather prolonged wet weather, of the nuisance caused on the Tyne foreshore by the drainage from old heaps, some of which have been deposited nearly a century.

Chance-Claus Sulphur Recovery Process.

Two plants for working this process exist in the district. Their united output of sulphur amounted to 10,196 tons. In 1893 10,700 tons were obtained. No alteration has been made in the plant for dealing

District No. 2—*continued.*

with the exit gases, which are burnt in a specially constructed furnace. The average total acidity of the chimney which carries off these gases after treatment is 1·50. The greatest care is exercised by the management to prevent the escape of any sulphuretted hydrogen, the chimney being tested eight times in 24 hours, beside which an automatic continuous testing apparatus is also employed. There is always danger of small quantities of sulphuretted hydrogen being given off when the "spent vessels" are discharged, but by keeping the pipes constantly flushed this can be reduced to a minimum.

Claus Sulphur Recovery Process.

There are three of these plants in the district; in two of them the exit gases from kiln are dealt with by means of lime scrubbers and oxide of iron purifiers, and in the case of the third the gases are burnt under a boiler fire.

Sulphuric Acid Works.

Sulphuric acid is manufactured at 19 works in the district; six of the plants are in connexion with the alkali process, seven with chemical manure, two with sulphate of ammonia, one with barium, and three works manufacture only sulphuric acid; at one of these the acid is concentrated in glass vessels. These latter, owing to breakage, cause a good deal of nuisance at times.

The following is the result of tests made during the year:—

Register Number of Works.	Total Acids of Sulphur and Nitrogen calculated as Grains SO_3 per Cubic Foot in Exit Gases.			Remarks.
	Max.	Min.	Average.	
355	1·10	0·90	1·10	
357	2·90	1·20	1·60	
363	1·10	1·10	1·10	
367	2·20	1·80	2·00	
370	1·80	1·00	1·60	
373	2·10	1·90	2·00	
374	2·40	1·20	1·60	
379	1·00	0·90	1·00	
386	1·60	1·00	1·20	
393	1·50	0·90	1·00	
399	1·10	0·90	1·10	
405	—	—	—	H_2S burnt (but idle).
407	1·50	1·00	1·20	
413	1·20	1·20	1·20	
422	2·50	2·00	2·10	
425	2·20	1·20	2·00	
428	1·50	1·20	1·30	
463	1·90	1·70	1·70	
458	2·60	2·00	2·10	H_2S burnt and barium residues.
District Average			1·49	

In no case have I had to complain of the total acidity of the exit gases exceeding the limit allowed by the Act. The average acidity is practically the same as last year.

District No. 2—*continued.*

The material chiefly used is pyrites, either as "stone" or "smalls."

Pyrites burnt	65,693 tons.
Brimstone burnt	99 ,,
Spent oxide burnt	202 ,,

At one work (barium) the entire quantity of acid made is obtained from waste containing a large percentage of free sulphur, and from the sulphuretted hydrogen evolved in one of the processes of manufacture.

Sulphuretted hydrogen is burnt as a source of sulphurous acid in three works.

Nitric Acid Works.

In three of the works in the district there are plants for the manufacture of nitric acid; they are all small, and in the case of one of the works the plant has been practically idle during the year.

Sulphate of Ammonia Works.

The number of plants at work in the district amounts to 43, an addition of four during the year. The amount of sulphate of ammonia produced was 6,470 tons, against 6,320 tons, 1893. The new works are all small, and the ammoniacal liquor which is produced in them was formerly consumed at other works in the district, consequently they do not practically add to output.

Patent coke producing works made 813 tons of the total output.

The "foul gases" are dealt with as follows:—

In 28, absorbed by "oxide of iron."

,, 3, decomposed by Claus process.

,, 2, used to remove arsenic from sulphuric acid.

,, 8, burnt in retort flues or under boiler fires.

,, 2, burnt in kilns for sulphuric acid.

Chemical Manure Works.

Thirty-eight chemical manure processes have been under inspection. There is no alteration of any plant to report, and with regard to the acidity of the escaping gases, no difficulty has been found anywhere in keeping within the limit. There is still considerable difficulty experienced in dealing with the smell when mixtures of blood, offal, or fish refuse are treated, either with or without admixture with phosphates.

The result of tests made during the year gives an acidity equal to 0·153 grains of SO_3 per cubic foot, against 0·144 grains in 1893.

Cement Works.

Three cement works have been closed and removed from the register during the year. There are still 14 in active operation in the district.

Salt Works.

There has been no increase in the number of these works during the year in the district, and the production has not been heavy. Three of the works continue to use the waste heat from the ironworks to evaporate

District No. 2—*continued.*

the brine. In the remaining four, where coal is burnt, the average of the tests shows an escape of chlorides and free hydrochloric acid equal to 0·166 grain of the latter per cubic foot, and a total acidity of combined chlorine and sulphur equivalent to 0·55 grain SO_3 per cubic foot in the escaping smoke.

Tar Works.

There are eight works in the district in which the distillation of coal tar is carried on. In all, with the exception of two small ones, which are also very intermittent in their operation, the gases given off during the process of distillation, and those also which are thrown off when the pitch "is run," are prevented from escaping into the air. The method employed is to conduct them by means of a pipe, with water seal, to either a boiler or still fire, and there allow them to burn.

Venetian Red Works.

Three works were registered under this head during the year. One of them has been idle. At another, whence an excessive escape formerly took place, this has now been prevented by the erection of efficient coke scrubbers.

Zinc Works.

There is only one of these works in this district; there is no change to report in the condition during the year.

Barium Works.

Two plants for the manufacture of barium compounds are at work more or less continuously in the district. In one, the whole of the sulphuretted hydrogen escaping from the decomposition of sulphide of barium is burned over "vitriol burners," and the resulting sulphurous acid is conducted to chambers. In the other work the gas is absorbed in copper solution.

There has been no prosecution under the Acts in this district during 1894.

Bernard E. Smith.

District No. 3.

Cheshire, North Wales, and part of Lancashire.

Annual Report for 1894.

Edward Geo. Ballard, Esq., F.I.C., *Inspector.*

The following is a list of the various classes of works registered under the Alkali Act in the district during the year.

The works in Widnes and Runcorn Sub-District are not included.

15	alkali works.
4	sulphuric acid works.
9	chemical manure works.
6	gas liquor works.
3	nitric acid works.
26	sulphate of ammonia works.
23	salt works, belonging to the Salt Union, Limited.
14	„ „ independent owners.
—	cement work.
1	alkali waste work.
5	tar works.
2	Venetian red works.
1	zinc work.
109	

The number of different processes carried on at the above works, and which come under inspection, is given below:—

12	alkali manufacture.
3	wet copper extraction.
17	sulphuric acid manufacture.
13	chemical manure manufacture.
7	gas liquor processes.
4	nitric acid manufacture.
29	sulphate of ammonia manufacture.
10	bleaching powder manufacture.
7	chlorate of potash manufacture.
38	salt manufacture.
—	cement manufacture.
2	alkali waste processes.
15	tar distilling processes.
2	Venetian red manufacture.
1	zinc smelting from ores.
160	

District No. 3—*continued.*

NUMBER of VISITS AND TESTS MADE DURING 1894.

—	Visits.	Tests.
Alkali works	192	518
Sulphuric acid works (exclusive of alkali works, but including some manure works).	28	63
Chemical manure works (exclusive of those making sulphuric acid).	21	9
Gas liquor works	18	—
Nitric acid works	11	—
Sulphate of ammonia works	107	—
Salt works	58	202
Alkali waste works	1	—
Tar works	24	—
Venetian red works	4	14
Zinc works	1	—
Total	465	806

IMPROVEMENTS EFFECTED DURING 1894.

765. Improved water supply on manure gas wash tower.
780. Vitriol chambers renovated.
814. New lids to bone boiling pans.
741. Erected a new Wilton saturator.
808. Improved the oxide purifier.
787. Erected a new saturator.
811. Built fine new purifier, 20 feet square.
885. Made arrangement for introducing air with foul gases going to the purifier.
889. Constructed new purifier in connexion with tar plant.

ALKALI WORKS.

With the exception of No. 757 I have had no cause to complain of the manner in which these works have been conducted, but at the particular work referred to, I have often had to draw attention to the low level escapes from the Hazenclever vitriol concentration furnaces, at the point where the acid is run off. Suggestions have been made for the suppression of the nuisance and it is hoped that shortly the escape of this pungent vapour will cease.

The chlorine departments continue to be carefully conducted and no complaints have arisen.

With respect to the salt cake furnaces and condensers, glass pipes for cooling the gases appear to be somewhat more popular, and are carried in one instance very close to the furnaces, without trouble or liability to crack.

District No. 3—*continued.*

AVERAGES OF THE TESTS TAKEN AT THE ALKALI WORKS THROUGHOUT THE YEAR.

Register Number of Work.	Acid per Cubic Foot of Chimney Gases calculated as SO_3.	Hydrochloric Acid per Cubic Foot of Chimney Gas.	Hydrochloric Acid escaping compared with that produced.	Total Acid per Cubic Foot of Gases escaping from the Sulphuric Acid Chambers.
	Grains.	Grains.	Per Cent.	Grains.
757	0·75	0·08	0·74	0·50
758	0·66	0·06	0·92	1·04
762	0·65	0·04	1·16	0·40
764	0·35	0·03	0·55	0·50
786	0·84	0·05	1·06	0·65
796	0·82	0·06	1·00	0·83
798	0·90	0·06	—	0·97
804	0·33	0·02	—	1·56
805	0·50	0·06	1·71	0·40
807	0·38	0·04	2·78	1·77
834	0·66	0·09	0·57	0·90
843	0·58	0·08	—	—
861	0·63	0·06	0·75	0·59
865	·70	·07	2·82	1·98
Average	0·62	0·05	1·27	0·93

SULPHURIC ACID WORKS (exclusive of Alkali Works).

TABLE SHOWING AVERAGE ESCAPE DURING THE YEAR.

Register Number of Works.	Materials used.	O.V. Exit. Total Acidity as Grains SO_3 per Cub. Ft.	Method of dealing with Gases from the last Chamber.	Material manufactured.
765	Pyrites - -	1·07	Gay-Lussac and Glover towers	Sulphuric acid and manure.
780	Pyrites - -	1·00	Coke scrubber and steam jet -	Sulphuric acid and manure.
809	Pyrites - -	0·44	Gay Lussac and Glover towers	Sulphuric acid and manure.
812	Pyrites - -	0·70	Gay-Lussac and Glover towers	Sulphuric acid and manure.
	Average -	0·80		

The average escape from all the sulphuric acid works in the district (excluding Widnes and Runcorn) = 0·86 grains per cubic foot.

There have been no complaints of escape of gas from this class of works and the chambers have been kept in good order.

District No. 3—*continued.*

Chemical Manure Works.

At every work for manufacturing superphosphate, wash towers are provided for the condensation of the gases evolved during the operation. Opportunities have not occurred to enable tests to be made as to the efficiency of all of these towers but some tests have been made and they are given below.

Table showing Condensation effected by Manure Gas Wash-Towers.

Register Number.	Total Acidity as Grains SO_3 per Cubic Foot.			Method of conducting gases to the Condenser.
	Average of Inlet to the Condenser.	Average of Outlet from theCondenser.	Average Percentage escaping.	
722	3·00	0·17	5·55	Fan.
765	10·50	0·82	12·49	Chimney draught.
780	8·80	3·60	40·99	Chimney draught.
803	10·00	0·15	1·50	Chimney draught.
809	6·02	0·32	6·77	Fan.
812	10·10	0·57	7·11	Chimney draught.
Average -	8·07	0·93	12·40	

The condensation at Nos. 765 and 780 is not at all satisfactory. The proprietors have been communicated with upon the subject and steps are now being taken to improve the wash tower in the case of No. 780, and, with respect to No. 765, a depositing chamber is in course of construction.

Gas Liquor Works.

Of the six works registered under this heading four are ammonia soda works. They are all in good order.

Nitric Acid Works.

There are three works of this description registered in the district. They are in good order.

Sulphate of Ammonia Works.

With the exception of No. 829, works of this class have been carefully conducted. A prosecution is now pending in respect to the work referred to.

Some of the sulphate of ammonia works in the district are covered by certificates for other branches of manufacture, but taking them together there are:—

20 working on the continuous system of distillation.
8 ,, ,, intermittent ,, ,,
18 absorb the sulphuretted hydrogen in oxide of iron.
9 burn it either under boiler fires or in retort flues.
1 converts the H_2S into sulphur in a Claus kiln.

The total quantity of sulphate of ammonia manufactured in the district during the year (excluding Widnes and Runcorn sub-district) = 3,280 tons.

District No. 3—*continued.*

Salt Works.

The numerous works of this class have all been visited and tests of the chimney gases taken in order to ascertain whether they are keeping within the limit of hydrochloric acid allowed by the Act. The pans are, as a rule, kept in a good state of repair.

Averages of Tests made at the Chimneys of Salt Works.

Register Number of Work.	Total Acidity of Chimney Gases in Grains SO_3 per Cubic Foot.	Hydrochloric Acid per Cubic Foot of Chimney Gases.	Register Number of Work.	Total Acidity of Chimney Gases in Grains SO_3 per Cubic Foot.	Hydrochloric Acid per Cubic Foot of Chimney Gases.
	Grains.	Grains.		Grains.	Grains.
749	0·57	0·03	800	0·77	0·04
754	0·52	0·03	854	0·45	0·02
745	0·59	0·04	841	1·05	0·07
755	0·52	0·04	802	0·77	0·03
737	0·51	0·03	842	0·55	0·03
744	0·85	0·04	748	0·75	0·03
797	1·60	—	720	1·11	0·05
852	0·72	0·07	858	0·10	0·06
769	1·15	0·03	781	0·50	0·05
775	0·43	0·04	742	1·07	0·06
779	0·70	0·04	857	0·53	0·04
730	0·56	0·04	815	0·30	0·03
871	0·63	0·08	872	0·25	0·03
813	0·92	0·06	740	0·90	0·11
756	0·90	0·06	823	0·52	0·04
770	0·72	0·04	864	—	—
864	—	—	752	0·98	0·06
847	0·60	0·16	746	0·57	0·08
736	0·50	0·05	Average	0·69	0·05

It will be observed that the hydrochloric acid is well within the 0·20 limit allowed by the Act and I have had no case this year of its being exceeded.

Alkali Waste Works.

There are two works of this class in the district for the recovery of sulphur by the Chance-Claus process, one of which is connected with an alkali work and is covered by the same certificate, but the other is registered separately. Both are carefully conducted, and I have received no complaints of nuisance arising therefrom.

Tar Works.

This class of works continues to be carefully conducted and a full description of the various methods adopted for dealing with the noxious vapours has already been given in the report for last year. A few improvements have been made, but beyond these there is but little change to record. It might be mentioned in passing that the workmen have often told me how much pleasanter the yards were to work in since the

District No. 3—*continued.*

gases have been prevented from escaping into the atmosphere. There are only five tar works registered as such in the district, but altogether there are 15 works where tar is distilled but 10 are already covered by other certificates.

Venetian Red Works.

There are only two works of this description in the district. At one the exit gases were found to attain the total acidity of 16 grains SO_3 per cubic foot. The proprietors have under consideration a plan for dealing with them, but hitherto they have been awaiting the results of experiments which were being conducted elsewhere.

Zinc Works.

There is but one work coming under this heading in the district, and it is situated in the country. Attempts have been made for dealing with the fumes from the retorts by drawing them off by means of a hood suspended over them, but the heat reflected down upon the heads of the workmen by the arrangement was unbearable. However, the matter is not to be abandoned and further experiments are about to be tried for collecting the fumes, as the loss of metal from the mouths of the retorts is very considerable, and is worth saving if possible.

Edward Geo. Ballard,
Inspector.

Widnes Sub-District.

(Widnes and Runcorn.)

The year 1894 closed with 25 works, the same number in 1893, on the register in this district. These are scheduled as follows:—

Alkali (including *wet* copper works)	15
Sulphuric acid	1
Chemical manure	1
Sulphate and muriate of ammonia	4
Chlorine	1
Nitric acid	1
Cement	1
Alkali waste	1

The only change is that a small sulphuric acid work, belonging to the United Alkali Company, has been withdrawn from the register, and a new sulphate of ammonia work of the Runcorn Gas Company added to it. The other works remain the same as they were in 1893, except in the case of No. 751, a nitric acid work, which has done no work all the past year, and in which the plant is now pulled down and completely removed. The proprietor does not intend to resume this manufacture, but for the past year the work has been continued on the register.

In these works there were 62 different plants in operation, which, as liable to evolve noxious gases, were subject to inspection, viz.:—

Sulphuric acid	13 plants.
Alkali—salt cake	13 ,,
,, *wet* copper extraction	3 ,,
Chlorine—bleaching powder	11 ,,
,, chlorates	2 ,,
,, chloride of sulphur	1 plant.
Alkali waste—sulphur recovery	7 plants.
Chemical manure	2 ,,

District No. 3—Widnes—*continued.*

Sulphate of ammonia	3 plants.
Muriate of ammonia	1 plant.
Gas liquor	3 plants.
Bi-sulphide of carbon	1 plant.
Cement	1 ,,
Lead deposit (drying and smelting)	1 ,,

Owing to the great depression in the manufacture of Leblanc products that prevailed for the whole of the year, most of the plants of that class, which form the great majority of the whole, were more or less intermittent and restricted in their working, only a very few being kept in anything like regular operation. In fact, during the last month of the year, several of the works of the United Alkali Company were entirely closed, and most of the others put on half work, so as to reduce the large accumulation of manufactured stock.

In respect of the nuisance caused by the escapes of chemical gases, the past year's working has been eminently satisfactory in this district. The only serious complaints made were in April and May, when some damage was unquestionably done to the tender shoots of the thorn hedges and to the hay and clover crops of a few farms to the west of Widnes. I found it impossible to determine whether this damage had been done chiefly by the acid smoke from the alkali works chimneys, or by that from the copper works. There were unmistakeable evidences of the copper works having at least contributed their share towards the damage done. For I tested several samples of cuttings from the hedge-rows, where they appeared to have been most burnt by the acid gases passing over them, and found in every case more or less copper deposited on the twigs.

Again, in the latter part of the year, complaints of strong escapes of chlorine taking place from time to time were brought against one of the largest works of the district by some of the people living in its immediate vicinity. In consequence of these complaints more stringent regulations have now been made with regard to the draughting of the bleaching powder chambers, and additional precautions adopted with the view of more readily detecting and stopping the first traces of any chlorine beginning to pass away with the steam from the exits.

With these exceptions there have been no serious complaints made in 1894 by the inhabitants of Widnes or Runcorn, either of damage or of nuisance caused by the works' gases; and none of any sort have reached me from the surrounding residential and farming districts.

During the year about 550 visits in all were paid to the different classes of works, and 1,344 samples of the gases escaping by the various outlets were taken and tested, to ascertain whether, on the one hand, the definite limits prescribed by the Act for some of them were not being exceeded, and whether on the other "the best practicable means" were being used for reducing the escapes of the others to a minimum. In both respects, I am glad to say, the excessive and abnormal escapes have been found less in number during the past year than in any previous one. Though this satisfactory state of things may properly be ascribed in some measure to the greatly restricted decomposition of salt, it shows likewise the high state of efficiency to which every section of the Leblanc plant has been brought in the works of the United Alkali Company by the liberal expenditure of the last two or three years.

The large alkali waste deposits around Widnes gave little or no trouble last year. As there is abundant Chance-Claus plant in operation to extract and recover the sulphur from the whole of the waste now produced, the deposits consisted almost entirely of the harmless "Chance mud" or carbonated waste, which is not at all liable to heat and cause a nuisance by giving off sulphuretted hydrogen. Though small quantities of untreated waste were from time to time deposited with the rest, when some of the recovery plants were stopped for repairs, or other reasons, these did not occasion any appreciable nuisance, being very soon covered up and protected from the air by fresh layers of Chance mud.

District No. 3—Widnes—*continued*.

I think we may safely say that Widnes is now effectually relieved from the very great nuisance caused by the *heating* of the waste deposits, a nuisance from which it has suffered for more than a generation past. But the *drainage* from the old deposits is still with us, and by the quantities of sulphuretted hydrogen it was found to be giving off at various times and places was much "in evidence" throughout the past year, claiming a good share of my attention. The evil is intensified in Widnes by the land being so low and flat that the drainage from the waste banks flows very slowly towards the river, and is therefore exposed for some considerable time to the decomposing action of the CO_2 of the air. This "yellow liquor" nuisance is one which will claim more and more attention from us in the future. Hitherto no practical method of dealing with it, at least economically, has yet been discovered.

In connexion with the waste deposits I may mention that a considerable nuisance, much complained of locally, was caused for the greater part of last year by a large deposit of cinders and general rubbish near to Ditton Ironworks getting on fire early in the year. The deposit is about 15 feet thick, and covers more than an acre of ground, forming a continuation of the very extensive "waste" banks of that neighbourhood. The area of the fire has been extending all the year, the gases given off by the smouldering mass being of the well-known disagreeable odour, in some places contaminated with a good deal of H_2S. Though I have addressed repeated remonstrances to the owners of the land, they have taken no effectual measures as yet to extinguish the fire, or even to prevent it spreading by cutting an intercepting trench, as was suggested to them. To all appearance the fire will now have to burn itself out till it reaches the walled faces of the adjoining waste banks, which will stop its further progress. We have, of course, no power under the Alkali Act to deal compulsorily with a nuisance of this sort, though the local sanitary authorities might interfere. It is mentioned here, because it has been erroneously stated in the neighbourhood, and also reported to the Board, that the "waste" deposits were on fire.

As only one work was added to the register in this district by the Act of 1892, and as both it and the other six alkali waste works had been practically subject to the same inspection as the older processes for some years previously, I have very little that is new to add this year to the reports of previous years, in which the various processes in operation have been minutely described. During the past year they have all been carried on exactly on the same lines as before, though in most instances on a very restricted scale. My duty will, therefore, be mainly confined to stating the average results of the tests made of the escaping gases throughout the year.

Alkali and Sulphuric Acid Works.

Total pyrites consumed in 1894 - - -
Total salt decomposed (including copper works) -

As usual, in this district, this class of works claims the largest share of the inspector's time and attention. In most of them, as already noticed, the processes were in very irregular operation, and the frequent changes and stoppages of sections of the plant were not conducive to lower escapes of the noxious gases. All of them were visited frequently, generally two or three times a month, and from time to time the condition of the plant was examined to ascertain its fitness and state of efficiency. On most of the visits samples of the acid smoke and vapours escaping by the chimneys, &c., into the air from the two processes were taken, and the amount of the acids they contained per cubic foot determined. The visits on which these tests were made numbered 373, and the number of samples of gases tested was 1,097. Of all these samples of gases taken, both from salt cake chimneys and vitriol chamber exits, it is most satisfactory to find that only *four* exceeded the Act limits of 0·2 grain HCl and 4 grains SO_3 per cubic foot, against *nine* in 1893, and *fifteen* in 1892. This is the smallest number of excessive escapes of these gases ever found in the

District No. 3—Widnes—*continued.*

district for a whole year among so many large and important works, and shows how perfectly in this respect the provisions of the Act are now being observed.

Owing to the large extensions and renewals of vitriol and salt-cake plant that were carried out during the two previous years, comparatively little was left to be done in this respect in 1894.

Of the 1,097 samples of the gases continually being discharged into the air from these processes, 668 were taken from the salt-cake chimneys, and 429 from the exits of the vitriol chambers.

In the following table are given the averages of all these tests for each of the works, and the quantities of salt usually decomposed per week.

ALKALI AND SULPHURIC ACID WORKS (WIDNES AND RUNCORN), 1894.

Register Nos. of Works.	Salt decomposed per Week.	Chimney Gases.			Waste Gases of Vitriol Chambers.
		"Acidity" per Cubic Foot in terms of SO_3.	Hydrochloric Acid.		"Acidity" per Cubic Foot in terms of SO_3
			Per Cubic Foot.	Per Cent. of total evolved.	
	Tons.	Grains.	Grains.	Per cent.	Grains.
724	160	0·60	·102	2·01	—
,,	—	0·33	·064	—	—
760	355	0·83	·109	3·12	0·91
,,	—	0·61	·098	—	1·20
,,	—	0·45	·087	—	—
,,	—	0·44	·065	—	—
,,	—	0·32	·063	—	—
763	270	0·90	·100	1·86	1·07
	—	0·93	·090	—	—
	—	0·80	·107	—	—
772	57	0·38	·087	4·41	0·80
783	140	0·65	·065	1·48	1·14
,,	—	0·58	·080	—	—
801	240	0·42	·109	0·87	1·80
806	140	0·97	·119	1·20	0·72
,,	—	0·62	·082	—	0·70
,,	—	0·33	·080	—	—
810	536	0·63	·092	2·03	1·30
,,	—	0·48	·085	—	—
817	100	1·57	·145	3·50	0·40
,,	—	0·50	·110	—	—
818	300	0·48	·110	2·38	0·24
,,	—	0·43	·109	—	0·49
833	210	0·63	·070	1·23	1·18
,,	—	0·49	·060	—	1·17
,,	—	—	—	—	1·44
835	165	0·74	·134	—	—
844	—	—	—	—	0·97
848	360	—	·114	1·64	1·03
,,	—	0·60	·061	—	1·38
,,	—	0·93	·118	—	—
850	250	0·51	·105	4·50	0·64
,,	—	0·29	·099	—	—
880	—	—	—	—	1·36
Total	3,083	—	—	—	—
Averages	—	0·615	·094	2·32	1·00
Do.—1893	—	0·67	·090	1·88	1·28

District No. 3—Widnes—*continued.*

It will be seen that the final averages for the whole district derived from the above compare favourably with those for 1893 given below them, except in the *percentage* escape of HCl. But with respect to this figure I may remark that it has been found almost impossible to determine it quite accurately for the past year on account of the frequent variations in the amount of salt decomposed from week to week in many of the works.

Of the 668 samples of chimney gases tested for HCl only *four* were found exceeding the Act limit of one-fifth of a grain per cubic foot of smoke against *five* out of 628 the previous year. The average of these four excessive escapes of HCl was no more than 0·245 grain, and the largest of them was only 0·28 grain.

Again, of the 429 samples of waste gases from the vitriol chamber exits that were tested *not one* was found with a "total acidity" above the four grains SO_3 allowed by the Act; a result that has never been obtained in any previous year. In no less than 13 of the 17 works now carrying on these processes no excessive escapes of acid gases above Act limits, either in salt-cake chimneys or in exits of vitriol chambers have been detected throughout the year.

Chlorine Works.

In this department of the Leblanc manufacture the chief feature of the past year has been the further extension of the Deacon process. This process for making chlorine is now in operation on a large scale at three of the Widnes works, and at three more of them large plants of the same kind are in process of construction, two of which are now about ready for work. Hence the quantity of salt that requires to be decomposed in order to obtain a given quantity of bleaching powder or chlorates is diminishing year by year.

All the various parts of the bleaching powder and chlorate plants, whether the chlorine has been made by the Weldon or by the Deacon process, have been maintained in the best of order during the year.

The Weldon chambers are regularly tested in all the works for the quantity of free chlorine left in them, before the doors are taken down for turning or packing of the powder, and the tests entered in a book which is open to our inspection. A final dusting with lime, applied either by means of the Minton machine, or by an air jet through the chamber roof, is in general use to absorb the excess of the gas, which is thus without difficulty, and very quickly, reduced to the 2½ grain limit fixed by the Chief Inspector.

One work (No. 870) still generates chlorine with native Manganese for the manufacture of chloride of sulphur; but there is little danger of any of the gas escaping in this process.

None of the revolutionary chlorine processes have yet been tried on a manufacturing scale in this district.

Alkali Waste Works.

The recovery of sulphur from alkali waste by the Chance-Claus process is still carried on as before by seven works in Widnes, though some of these, as was to be expected, worked rather irregularly most of the past year. Three of these were entirely stopped along with the other processes at the beginning of December for want of sufficient waste to keep them employed, and have not yet started work again.

No change worth noticing has been made during the year, either in the construction of the apparatus employed, or in the method of working. I have therefore nothing more to add to the full particulars already given regarding this process in previous reports. Neither, I regret to say, has any method been yet found for reducing the high percentage of the sulphur lost in the waste gases of the Claus kilns, which remains much the same as in previous years. A small portion of these gases (how much it is impossible to say with any degree of accuracy) is still utilised in three of the works by passing them through the pyrites burners to the vitriol

District No. 3—Widnes—*continued.*

chambers. But by far the greater portion continues to be sent (after complete oxidation to SO_3) to the chimneys.

These chimneys are now 10 in number, and have been very frequently tested in order (1) to make sure that no sulphuretted hydrogen was passing away unburnt, (2) to ascertain the degree of acidity given to the smoke by SO_2 produced in the combustion.

In all 206 samples of the smoke from these chimneys were tested, and gave the following average "total acidities" for the year, calculated in grains SO_3 per cubic foot:—

No. 647.		No. 763.	No. 768.		No. 806.	No. 810.	No. 833.	No. 848.	
I.	II.		I.	II.				I.	II.
0·68	0·75	1·64	2·31	3·17	1·95	1·37	0·90	1·23	1·95

The considerable diversity shown in the degree of acidity of the smoke of these chimneys is of course due to the greater or less dilution of the sulphurous fumes which has been found practicable in the different works. It would undoubtedly be a great benefit to the district to have the smoke-acidity of all these 10 chimneys reduced below 1 grain SO_3, as three of them already are, even by air dilution. I have repeatedly urged this upon the proprietors, but they find it impossible to do so in every case, and maintain at the same time a working draught in the chimneys.

At work No. 747, where the acidity is lowest, there is not only a very long flue between the Claus kilns and the furnaces burning the waste gases, but these are divided between two chimneys which receive a large volume of fuel gases. At work No. 768, where it is highest, though the gases are now divided between two chimneys, there is no appreciable dilution from any other process. The drying and smelting of the lead deposit from vitriol chambers, which is the only other process now carried on in that work, also sends a good deal of sulphur acids to one of the chimneys, and is therefore of little service in diluting the gases coming from the Chauce process.

Chemical Manure Works.

The two works of this class have been in full and regular operation throughout the past year, producing about 60,000 tons of chemical manures. The output has been increased. Otherwise there is very little change in the two plants, which have both been maintained in the very highest state of efficiency.

There have been no complaints of any nuisance caused to the neighbourhood by this process.

At No. 810 the method of neutralising the acid wash water discharged from the scrubbers with caustic lime sludge before allowing it to flow into the drains, which are liable to be contaminated with calcium sulphhydrate, has not been found quite satisfactory, so that larger neutralising pits are about to be constructed.

At work No. 844 the floors over the dens have been entirely renewed.

The tests of the "total acidity" of the gases evolved in this process taken throughout the year numbered 41, of which the following are the averages for the two works:—

——	No. 810.	No. 844.
Gases leaving mixers. Grains SO_3 per cubic foot	13·65	59·20
Gases leaving scrubbers. Grains SO_3 per cubic foot	0·32	0·80
Percentage of acids condensed - - -	97·66	98·65

District No. 3—Widnes—*continued.*

The difference between the two works in the degeee of air dilution of the acid gases coming from mixers and dens is as marked as in previous years, the work dealing with the gases in the more concentrated form having the best percentage condensation.

Sulphate and Muriate of Ammonia Works.

There are now four works of this class in the district, three of sulphate and one of muriate, which together have produced during the past year a quantity of the two salts equivalent to 942 tons of ammonium sulphate.

All the four have been well conducted and maintained in an excellent condition, giving no occasion for any complaints.

At work No. 884 a perfectly new sulphate of ammonia house and plant has been in process of erection for some months past, and is now approaching completion, the capacity of which is 2 tons of sulphate per diem, in place of the old one of one-third that capacity. The stills employed for the new plant are those of Dempster & Co. of Manchester, which have the advantage of giving an increased area of contact between the liquor and the steam. For dealing with the foul gases evolved from the saturator, what ought to prove a very efficient apparatus is now being completed, composed of scrubbers or condensers, and oxide purifiers of ample capacity.

The object of the scrubbers, of which a sketch is given, is not merely to dry the gases before they are passed into the purifiers, but to recover any ammonia that may escape from the saturator; and, as the overflow from the scrubbers is placed at a higher level than the saturator, the condensed liquors can either be run back there, or forced back into the stills by means of the lime pump.

There are two oxide of iron purifiers, the capacities of which are 607 and 455 cubic feet respectively, fitted with valve arrangement for working them either separately or together. In each purifier the oxide is placed in two layers, each 2 feet 6 inches thick; and the intention is, when the arrangement is complete, to revivify the oxide in situ by means of air forced through the purifiers by a small steam injector.

At work No. 767 considerable alterations and improvements of the plant have been executed during the year, consisting of two new saturators on improved principles, two new extra scrubbers, greatly increased lengths of condensing pipes, and six extra condensing boxes.

At work No. 782 all the boiling down pans for the muriate of ammonia liquors have been rebuilt and completely cased in to prevent any of the foul-smelling steam from escaping directly into the air before passing through the hot flue behind the pans. The subliming pots have also been rebuilt, and the whole plant thoroughly overhauled both in regard to construction and arrangement.

The new plant belonging to the Runcorn Gas Company, which has recently been added to the register, is very well designed and most substantially constructed, having a capacity of one ton of sulphate per diem.

Bisulphide of Carbon Works.

The only work of this class in the district is in the main well conducted, but considerable remissness has been shown by the proprietors during the past year in not providing a proper and efficient means of dealing with the waste gases coming from the process. These consist chiefly of sulphuretted hydrogen and any bisulphide of carbon vapour that escapes condensation in the receivers and oil scrubbers. After a great delay a small oxide purifier was at last put up and connected with the exit pipe; but as the oxide got overheated and caused a slight explosion in the very inflammable gases, it was abandoned for a time. It is to be tried again,

District No. 3—Widnes—*continued.*

more attention being given to prevent overheating. However, a *wet* oxide purifier is clearly the safest for this process, and I have recommended this form to be adopted, which I expect will be done.

J. Affleck.

Woolton, near Liverpool,
16th January 1895.

District No. 4.—East Lancashire and part of Yorkshire.

R. Forbes Carpenter, Esq., F.I.C., *Inspector.*

At the close of 1894 there are in this district 191 registered works under inspection, a net increase of 5 during the year:—

	1894.	1893.
Alkali works	30	31
Other scheduled works	161	155
Total	191	186

The number of separate processes under inspection is 326, as shown by the following table:—

	1894.	1893.
Alkali	13	13
Copper	2	2
Wool carbonisers (decomposing salt)	5	6
Cylinder muriatic acid	11	11
Nitric acid	40	45
Sulphuric acid	36	38
Chemical manure	9	9
Gas liquor, or liquor ammonia	20	20
Sulphate, or muriate of ammonia	51	50
Chlorine	8	8
Cement	3	3
Sulphur recovery, or alkali waste works	8	6
Bisulphide of carbon	2	2
Arsenious and arsenic acid	7	6
Nitrate and chloride of iron	45	41
Fibre separation	28	24
Tar	38	35
Total	326	319

In spite of the reduction of the district in 1894 by the transference of 22 works east of Leeds and north of the Humber to the Newcastle, or No. 2 District, I have been unable to cope satisfactorily with the increase of work imposed by the operation of the amended Act of 1892. The number of works and of scheduled operations tends to increase, as will be seen by reference to the two preceding tables.

District No. 4—*continued.*

I had in March and November the assistance of Mr. E. M. Fletcher in visiting the wool carbonising works, and in making tests of the escaping gases, the results of these are embodied in the general table relating to this class of work. It is probable, in fact certain, that all the works conducting this manufacture are not yet registered, the local authorities not having responded at all completely to the circular issued by the Local Government Board in October, 1892, so that it is only by chance information that knowledge of the existence of an unregistered work can be arrived at.

In all, 874 visits have been paid, and 720 tests made of the various exits and processes, of which Mr. E. M. Fletcher made 51 visits and 57 tests (52 tests being in the one class of works above referred to). Of the 720 tests, 413 have been made in alkali works, which still form the class needing the most frequent attention from the magnitude and variety of the operations conducted.

Many problems have arisen during the year which it would have been desirable to study and investigate, but time did not permit of this with so many works all claiming attention, and I regard it as absolutely necessary for efficiency that the visits to alkali and vitriol works should not be lessened in frequency, else the standard attained would run the risk of being lowered; I urged this consideration in last year's report.

ALKALI AND COPPER WORKS.

TABLE showing the Amount of Acid Vapour escaping from Exits in Alkali Works, averages being given of all the tests made in the year:—

Register Number of Works.	Chimney Gases.			Total Acids in One Cubic Foot of Exit Gases from Vitriol Chambers in terms of SO_3.
	Total Acidity per Cubic Foot in terms of SO_3.	Hydrochloric Acid.		
		Per Cubic Foot.	Per Cent. of Total evolved.	
	Grains.	Grains.		Grains.
1065	0·65	0·068	2·40	0·56
1068	0·50	0·029	0·86	0·93
1077	0·44	0·121	—	—
1107	0·34 1·15	0·039 0·027	1·18 —	1·40 —
1111	0·72	0·091	1·92	·26
1137	0·84	0·129	—	0·76
1144	0·65	0·044	—	1·22
1147	0·33	0·051	2·27	1·89
1150	0·90	0·060	0·33	0·62 0·68
1156	1·02	0·108	2·20	—
1158	0·50	0·040	2·80	1·49
1162	0·56	0·060	2·36	1·54
1175	0·49	0·038	0·61	0·55
1190	0·64	0·091	2·36	0·96
1234	—	0·053	—	1·13 1·28
Average 1894.	0·65	0·066	1·66	1·08
Average 1893.	0·51	0·066	1·59	1·10

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	1894.	1893.
	Per cent.	Per cent.
Percentage escape of hydrochloric acid in open furnaces -	1·99	1·83
" " " " close " -	1·26	1·33
" " " " all " -	1·66	1·59

The total quantity of salt decomposed in alkali and copper works during the year is 38,722 tons. The number of visits paid has been 182, and of tests made 413, of which 149 were for HCl in chimneys or flues; none of these exceeded Act limits as regards grainage, but one flue test at 1190, taken at the time the anemometer determinations of speed were being made, showed an escape of 7·36 per cent. Steps were at once taken to remedy this, and successfully, by the lowering of damper, equalisation of HCl supply to condenser by working smaller and more frequent charges. The difficulty lay in the condensers being worked without supplementary wash tower. Acid is required for sale, and the water supply is regulated carefully by the strength of outflowing acid; when the charge in the furnace (which is of Jones and Walsh type) is nearly finished, and a minimum of acid is evolved, the very small water supply could not be equally distributed through the condenser, but tended to make channels. Of 169 tests of 15 vitriol exits (an average of 11 per exit) 7, or 4·1 per cent., exceeded Act limits; they occurred in six works; one of these infractions, occurring at No. 1147, was really produced by draughting the exit of the cast-iron vitriol rectifying pot direct to the Gay-Lussac tower, after absorption of SO^3 in the surface condenser, as on turning this escape through the old condensers the vitriol exit at once dropped 2 grains SO^3, the escape having been 5·30 grains SO^3 per cubic foot. No other infraction calls for detailed notice in this report.

Plant has been maintained in good order and efficiency. At one of the copper works a cooling flue for the gases before entering the condenser has been added, as from some cause not yet quite explained the coke in the latter fired, and the stones of the condenser cracked to such an extent that rebuilding was absolutely necessary. At Nos. 1137 and 1158 extensive rebuilding of vitriol chambers has been carried out, with the building of a fine Glover tower at the latter work.

Sulphur Recovery from Alkali Waste and Drainage.

In only one work are waste and drainage treated by the Chance-Claus process, the other two dealing with waste drainage alone.

Tests from the exit flue of the combustion furnace dealing with the residual gases from the Chance-Claus process show an average total acidity as SO^3 of 1·61 grains per cubic foot (maximum 2·70, minimum 1·02); on three out of 14 occasions when tested, H^2S in small quantity was found to have escaped combustion; the alterations and added baffle arches in the furnace are satisfactory, but do not give the complete margin of safety hoped for. During the last six months, however, the working has been better organised, that of the Chance-Claus process proper has from the first left nothing whatever to be desired.

At the two works, 1107 and 1158, dealing with drainage liquors, compulsorily so on account of action taken by the Mersey and Irwell Joint Committee, the conditions vary considerably; at the former the liquors to be dealt with are extremely weak and the acid used for decomposition is extremely impure, it is, in fact, an endeavour to work up two waste products without hope of gain. The resulting H^2S passes to a

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combustion furnace and thence to a chimney, which also takes the vitriol exit, the average "total acidity as SO^3" of which is 1·15 grains per cubic foot. Combustion of H^2S has been always perfect, both here and at 1158, where, however, so little escapes the treatment subsequently described that the total acidity as SO^3 amounts in the chimney to only 0·50 grains per cubic foot. The gases from the decomposer containing both H^2S and SO^2, but principally H^2S, are used partly for purifying muriatic acid from arsenic, but also are treated in a way that I think is novel. They are drawn by chimney draught, which ensures an indraught of air at the decomposer, up two coke columns placed in sequence of 15-inch sanitary pipe about 10 feet in height, down which run streams of yellow drainage liquor, when the following reactions take place; firstly, the H^2S is absorbed with formation of sulphydrate or polysulphides of calcium; and, secondly, some of these are oxidised to hyposulphite of calcium, this reaction being even more active than the former; liquors going on the tower 12 to 1 by Mond notation, *i.e.*, 12 equivalents, CaS^2 to $1CasS^2O^3$, coming off 8 to 1. As regards absorption of H^2S, 87 per cent. H^2S, and all SO^2 present were absorbed in the first column put up experimentally, the maximum passing the tower being 2·4 grains S as H^2S per cubic foot; combustion of this was ensured before the chimney was reached. The effect of the oxidation of the liquors is beneficial in increasing yield of sulphur, and in diminishing that evolved on decomposition as H^2S, diminishing therefore the work to be done by the catch column.

On addition of the second column the absorption of H^2S rose to 94 per cent., with a maximum passing of 1·25 grains S as H^2S per cubic foot. The working out of this process has been watched with great interest as the results proved unexpected.

Chlorine.

The consideration of this subject may be taken here before leaving that of alkali works, as it is at this class of work that the bulk of the chlorine is generated, only one of the eight works under the schedule this year not being an alkali work. The average figures of residual chlorine in bleach chambers in the only two works making a considerable amount by the Weldon process are:—

Register Number of Works.	Grains Chlorine per Cubic Foot of Chamber Gas.		
	Maximum.	Average 1894.	Average 1893.
1111	2·08	1·50	1·29
1150	2·18	1·45	1·32

At the work mentioned last year as preparing to make bleaching liquor by Deacon's chlorine process, some difficulties were encountered at the start in getting complete absorption of the last traces of chlorine in the dilute gas. The desired end was attained by speeding up the agitators in the absorbers so as to give more continually fresh surfaces of lime for reaction with the gas.

HCl in Coal Smoke.

Time has not permitted me to extend my tests to coal smoke from boilers and other furnaces so as to arrive at figures representative of the different seams in the same coalfield, as well as of different districts. I

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can, however, supply the following figures taken from a few notes I have been able to make:—

Coal from Normanton District.	HCl.	Total acidity as SO_3.
Three tests, Haigh Moor and Warren House, mixed	0·098	0·68
Two tests, Silkstone smudge	0·048	0·93
As regards Lancashire coal, I have only one test to give from a colliery between Manchester and Bolton, and the total acidity being taken in the chimney contained sulphur-acids other than from coal	0·022	—

The tests of Haigh Moor and Silkstone coals confirm those given in XXIX. Report, pp. 74, 75.

Sulphuric Acid Works.

Table showing the Total Acids in One Cubic Foot of Exit Gases from Vitriol Chambers in Terms of SO_3 (including those in Alkali Works).

Register Number of Works.	Average Grains SO_3.	Register Number of Works.	Average Grains SO_3.
1065	0·56	1137	0·76
1068	0·93	1143	1·30
1075	1·47	1144	1·22
1081	2·01	1147	1·89
1083	1·42	1150	0·62
1085	1·04	1150	0·68
1086	1·55	1158	1·49
1089	1·80	1162	1·54
1097	0·56	1163	0·55
1103	0·90	1164	1·51
1104	1·07	1165	0·70
1105	1·46	1166	1·27
1107	1·40	1167	1·73
1111	1·26	1172	0·98
1116	1·35	1175	0·55
1120	1·10	1190	0·90
1120	1·37	1198	1·20
1124	0·78	1234	1·13
1133	1·13	1234	1·28
Average 1894			1·17
Average 1893			1·21

In the 22 works, other than alkali works, making sulphuric acid, 180 tests have been made of the 23 exits, an average of 8 per exit, of which 10, or 5·5 per cent., occurring in seven works, exceeded Act limits; the corresponding figures for 1893 were eight tests (3·9 per cent.), occurring in six works. Though the point reached in 1893 has not been maintained, yet the results of 1894 do not depart largely from it, and I have not had serious cause to consider any infraction as one calling for prosecution. At No. 1089, the difficulties were caused by the presence of the cyanogen

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compounds in the oxide used; at the outset the manager did not discover immediately the source of his difficulties, and telegraphed for my assistance and advice; the chambers did not recover normal working till the oxide had been thoroughly washed, and some nitric acid had been run down the Glover tower, the wet oxide not yielding sufficient heat to work off the nitre pots. I may here remark what a valuable adjunct a few carboys of nitric acid are in a work not possessing self-fired nitre pots in emergencies of this nature. I have in previous reports emphasised the importance of control of the nitre supply during unfavourable working conditions, and of the aid given hereto by the adoption of self-fired nitre pots, which in the absence of available nitric acid may be classed as one of the "best practicable means" required by the terms of the Act of 1881. One infraction, also at a work burning spent oxide, occurred from the turning off of steam to repair a leaky pipe; one, from the causes of instability mentioned in XXX. Report, p. 65, of having too little working stock of acid in the chambers at the same time that the chamber space itself was pressed, was removed only by the ore burned being reduced; this was at once done on my representation of what would follow if I came and found another infraction; the work was otherwise very carefully and well conducted.

No. 1075 disappears at the close of the year from the list of registered works, being now entirely dismantled. No. 1167 is idle, and has been so for the greater part of the year; it is doubtful if operations will be resumed in 1895.

Plant has been maintained generally in good order, and extensive renewals have been made at several works. Where Gay-Lussac towers have to be emptied and repacked, I have found managers quite alive to the necessity of having a draught of fresh air at command so as to draw *downwards* and away from the men engaged any of the acid nitrogen oxides evolved from coke packing or brick lining; still the necessity of observing precautions cannot be too frequently enforced.

TABLE showing the TOTAL ACIDS in terms of SO_3 in gases leaving the exits of CONDENSERS OF RECTIFYING APPARATUS.

Register Number of Works.	Grains SO_3 per Cubic Foot.	
	Intermittent Process.	Continuous Process.
1065	2·11	—
1168	0·50	—
1085	—	0·56
1089	0·82	—
1120	—	1·86
1133	—	3·07
1137	—	1·72
1147	8·73	0·61
1150	—	0·07
1162	0·78	—
1163	0·62	—
1175	—	1·71
1198	—	2·34
1234	—	0·45
Average	2·26	1·38

Very great activity continues to be displayed among vitriol makers in introducing and in experimenting with various modifications of the continuous rectifying processes mentioned in the last two reports (XXIX., p. 76, XXX., pp. 66, 67). Enamelled cast iron has been tried as a material

District No. 4—*continued.*

for the rectifying pots, but it is probable that the loss of time involved in stoppages to replace worn out pots, and the cost of new ones, will outweigh the advantages of saving in fuel through the superior conductivity of the iron vessel over one of glass or porcelain. The latter seems to be the favourite material with many rectifiers, and the loss by breakage has certainly been reduced to a very low point. In one installation 21 porcelain pots, stepped in series, concentrate the acid to O.V. from chamber strength without the aid of any lead concentrating pan. The same work is also done with a fewer number of glass vessels, but with greater liability to breakage. The closer study of the working of the processes increases my belief that the best lines on which to approach the problem of how best to condense the acid vapours evolved is to separate the vapours containing much SO^3 and little water, arising from the lower vessels in the series, from that containing much water and less SO^3 coming from the upper vessels, these latter being dealt with in the usual way by cooling in a lead trunk, and leading to a final coke scrubber. So much success has attended the plan, hitherto however, but partially carried into effect, of absorbing the strong SO^3 vapours by *surface contact* with liquid acid of a strength preferably exceeding 145° F., that I am anxious to see this method more widely adopted. It is based on a reaction well known to makers of sulphuric anhydride, who make the higher strengths of vitriol required by passing the vapour of anhydride over trays containing the liquid vitriol to be strengthened up to the higher percentages, till the desired point is reached.

In XXI. Report, p. 45, I mentioned the success that attended the method adopted at No. 1144 of having a stream of water, or weak vitriol, flowing through the trunk in a direction contrary to that taken by the vapours, the stream being used when the strong SO^3 vapours commence to be given off. At the time I thought the success of the method in reducing the condenser or scrubber space required to be due to the complete intermingling of steam and SO^3 so that in the scrubber both condensed together. I incline now to think that the scrubber has very much less work than usual to do, the acid in the trunk (and the stronger this acid is the better) doing the bulk of the absorption by *surface contact* alone. Certainly the surface contact principle has shown itself superior to the scrubber, as far as my observation has gone in the most trying case that came under my notice, where, from a cast-iron rectifying pot of the type known as the Menzies pot, the opaque white vapours given off when the acid reached 93 to 94 per cent. monohydrate were completely absorbed by a surface of acid that was only 116° F., a very considerable quantity of *transparent* gas, probably SO^2 (43·6 grains SO^2 per cubic foot) passed on to the vitriol chamber. I had not the opportunity of checking this conclusion by direct estimation of SO^2 present with iodine, but experiments and tests will be continued by the work's chemists, as the point is one of great interest, and time has not permitted my making continuous and personal study of the problems to be solved. The tests made of 16 exits of condensers number 36, of which four exceeded Act limits as regards grainage, but the highest test of "Total acids as SO^3" in the flue to which the whole vitriol department is draughted in the work carrying on the rectifying process on the largest scale is 1·60 grains per cubic foot, and in the work's chimney 0·84 grains. Apart from the high average at No. 1147 (maximum test 24·5 grains SO^3) the tests taken from the intermittent process show a lower average (0.96 grains SO^3) than those from the continuous processes. The extremely low escape at No. 1150 from a platinum rectifying plant, making O.V. of 95 per cent. monohydrate, is very noteworthy, the only condenser being the Liebig condenser attached to the head of the still, tending to confirm the impression, already existing in my mind, that of all the materials used in the rectifying vessels for strengths above 94 per cent. monohydrate there is the least dissociation and the least reduction to SO^2 with platinum and the greatest with cast iron. It should,

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however, be borne in mind that to obtain acid of 96 per cent. monohydrate, glass or porcelain vessels are invariably used, as the wear and tear on a platinum vessel increases very largely with every ½ per cent. monohydrate, above 94 to 94·5. A valuable contribution to this subject was made by Mr. F. Tate in his paper read before the Liverpool Section of the Society of Chemical Industry (Journal S.C.I., Vol. XIII., pp. 206–11), and in the discussion which followed.

In the concentration of vitriol to the strength known as B.O.V., 148–150° F., usually conducted in under-heat lead pans, escapes of acid vapour from leakage from the pan into the fire flue not infrequently occur, and come under the notice of the inspector from the volume of dense white vapour issuing from the top of the chimney. Various attempts have been made to prevent these leakages, generally caused by burning through of the iron plates on which the lead pan rests, and which receive the brunt of the direct heat of the fire. One plan is to concentrate by overheat by means of a coke fire playing over the surface of the acid. In the method described by Mr. F. J. Carulla (Soc. Chem. Ind. Journal, Vol. XII., pp. 15–20), and patented by him, a thin sheet of copper is interposed between the iron and lead to disperse, by its superior conductivity, the effects of local overheating over a wider area. In the method devised by Mr. McDougall, for which provisional protection has been obtained, the iron supporting plate is cast with diamond-shaped openings, very much resembling in appearance a deck grid; the distance from the fire is somewhat greater than usual, and the fire itself is kept like a thin steam boiler fire. Certainly the results have been so far very encouraging, as apart from the saving of fuel claimed, which is considerable, the wear and tear of the pan is very much reduced. At the close of the year I examined the inside of a pan which had been in active work since August, and had concentrated over 300 tons of acid from 100° F. to 148° without having buckled in the slightest degree, showing that no local overheating had taken place. Much depends on the care and skill of the fireman.

Chemical Manure Works.

At only three of the nine works registered under this schedule are mineral phosphates dissolved, and at one of these the vitriol exit passes to the same condenser as the gases from the manure mixer and den, so that percentage results cannot be obtained. The average results are: 5·96 grains as SO^3 leaving mixer and den, and 0·26 grain as SO^3 per cubic foot leaving condenser, showing 95·9 per cent. condensation. Plant has been maintained in good order; a more powerful fan to draw gases from mixer and den at No. 1086 has been added, and both here and at No. 1172 great attention is paid to minimise escape of all kinds.

The plant and destructor furnaces at the two Corporation works for dealing with excreta are in a high state of efficiency. At No. 1153 the rotatory concentrating machines have all been levelled, and care has been taken to stop all possible in-leakages of air, with the gratifying result of ensuring the complete efficiency of the destructor at all times. The manager has adopted Meldrum's steam-jet blast to the steam boilers and furnaces burning the town refuse with great success, the air is drawn to the concentrators from the closed chamber above, where all the excreta are received and stored, thus minimising local escape of nauseous vapour.

Gas Liquor Works.

There is only an addition to the register of one work during the year. The total quantity of gas liquor worked up into sulphate and muriate of ammonia, as well as into liquor ammonia, crude, refined, and anhydrous,

District No. 4—*continued.*

is equivalent to 24,484 tons of sulphate. To exhibit results comparative with those of 1893, I append the following table :—

		1894.	1893.
Total quantity of liquor distilled equivalent to sulphate - - - - - tons		24,484	24,320
Proportion per cent. distilled to liquor ammonia -		16·1	15·5
Proportion per cent. sulphate and muriate made by continuous processes - - - -		96·7	94·6
Proportion per cent. liquor ammonia made by continuous processes - - - - -		86·7	79·5
Method of dealing with foul gases evolved in manufacture of sulphate and muriate of ammonia - -	To vitriol chambers, per cent.	34·0	32·1
	By Claus process „ -	10·4	12·5
	Absorb in oxide of iron or lime, per cent. - -	47·6	47·7
	Other methods, per cent. -	8·0	7·7

No changes of great importance as regards method of dealing with the gases evolved have to be recorded, though the Claus process has been adopted by one more work that started with oxide purification. It is impossible to apportion more than approximately the percentage going to vitriol chambers, as in one large work the balance only of the gases goes in this direction, the decomposition of carbolate of soda by the carbonic acid contained in the gases being the first use to which the foul gases are put; for this latter use of course the sulphuretted hydrogen has first to be removed, and this is done in closed oxide of iron purifiers similar to those in use in gasworks.

The suggestion made, XXX. Report, pp. 69, 70, that purifiers should be aerated before emptying by using a Körting, or similar, air injector, the steam used preventing undue heating of the oxide, has been adapted at one works to the continuous regeneration of the oxide, while working the sulphate plant, and at another, to that of intermittent revivification during the night, the sulphate plant working by day only.

Mention was made in the closing paragraph of last year's report on this class of works, p. 70, of the first prolonged trial of continuous revivification during work. I am enabled, through the courtesy of Mr. Thomas Duxbury, engineer to the Darwen Corporation Gasworks, to supply the additional following particulars. As I was not satisfied that any air was actually passing to the purifier from the fan in use for the steam boilers (Perret's system of fire bars) the evidence of the gauges only bearing testimony to pressure not to passage of air, I asked Mr. Duxbury to fix a meter on the 2″ branch air-pipe passing to the purifier, and to record daily the amount passing. This was subject to considerable variation, as was but natural considering the variation, *a*, in thickness of steam boiler fires, *b*, in resistance of the oxide by caking, &c.; the results however, viewed in toto, are as follow :—

Cubic capacity of oxide in purifier, 20′ 9″ × 6′ 0″ × 2′ 6″ = 311 feet.

Sulphate of ammonia made in 24 hours (continuous process) 15 cwt. 3 qrs. dry weight.

Cubic feet air passed through during (32) days of working :—Maximum, 5,800, minimum, 300, average 2,081.

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Cubic feet air passed through in between working days, when plant was stopped—80,500.

At the meeting of the Gas Institute in July 1894, Mr. Dexter, of Winchester, communicated a paper giving detailed report of results obtained of continuous revivication of oxide in the (closed) gas purifiers at his works by air admission, coupled with a certain proportion of steam. He very clearly showed how, with air admission only, the temperature of the purifier rose and the stream of gas was equally raised in temperature, its capacity for carrying moisture rising likewise, so that in time the oxide would be deprived of the water necessary for the purpose of revivification, and finally in consequence caked and aggregated together until its back pressure necessitated the isolation and changing of the purifier. This paper clearly brought out the cause of the back pressure, and its cure by the concurrent admission of water vapour with the air, so as to keep present in the oxide moisture enough for the purposes of the reaction, and replace the loss of that carried away by the gases passing from the purifier at a higher temperature than that at which they entered. The principle and method are exactly applicable to the conditions existing in sulphate of ammonia purifiers, where hitherto back pressure has been the cause necessitating change of purifier, if indeed the oxide had not fired through local overheating. On drawing his attention to this paper, I found Mr. Duxbury had already for himself been led to make experiments in this direction, having noticed that he got the best results when the oxide was wet (after rain). He is certain that with this method his purifiers run from three to four times as long without needing change. On the occasion of my last visit the fan had been disconnected, and a temporary steam air injector was in use; the temperature of the purifier showed the activity produced by the method, and from the surface of the oxide there was no appearance of vapour of water in the issuing gases. I think there is every promise that this method may prove of real service to works depending on the oxide method of purification, where the cost of frequent emptying and refilling entails considerable expense.

As regards disposal of the water passing from the condensers, known from its offensive smell as "devil water," in gasworks or vitriol works using spent oxide, an easy method exists of making this innocuous and fit to run into the drains. It consists of having two vats, to be used alternately, filled with spent oxide through which the devil water can filter; often sufficient ammonia is recovered in the wash water to make the process when systematically conducted a paying one; moreover, in many vitriol works the washing of the oxide is a necessary precautionary measure to remove sulphocyanides and other cyanogen compounds; these latter too are now greatly in request for the manufacture of cyanide of potassium for recovery of gold from the tailings hitherto considered an unprofitable operation, but now receiving enormous development in South Africa.

On reference to the table showing the percentage of gas liquor distilled for sulphate and muriate manufacture, by continuous and intermittent processes respectively, it will be noticed that the former continues to increase in favour with manufacturers; in no single case has the principle been abandoned when once adopted. It is natural to infer that considerable economies are found to result, as well as better control over the foul gases evolved. There are many forms of continuous still, but most are variants in greater or less degree of the Feldmann still, in which the hot vapours and steam in passing upwards bubble through thin films of liquor on trays superimposed over a lime chamber, the liquor descending being first deprived of its free ammonia, and subsequently to the lime chamber, of its fixed ammonia on more trays of similar type. Success depends on subdivision of the bubbles of vapour, and various devices have been adopted to better attain this object, and at the same time to diminish the risk of clogging up either with tarry matters, or after the lime chamber, with carbonate and sulphate of calcium. From time to time it is found necessary to take the whole still apart and chip

District No. 4—*continued.*

off the deposit; a break in the manufacture occurring during the summer gives time and opportunity for this. In a new still patented by Messrs. Peter Spence & Sons, this type is departed from, and the old principle of *surface contact* is again adopted. The still, constructed of steel, is greatly simplified thereby; access to remove obstruction, should any occur, is rendered extremely easy, and the quantity of gas liquor passed through in a given area very largely increased. The gases, being in this instance used after cooling and drying to contribute sulphurous acid to the vitriol chamber, come off with great regularity, and no hanging up or priming of the liquor has been noticed. The height of the still, with its 25 trays and lime chamber, 27 feet, is perhaps greater than usual, but the superficial area, 9 feet × 3 feet, is smaller in proportion to the height. The rectangular form of still gives a great amount of travel for the liquor, the depth on the trays being ¾ to 1 inch. I thought it possible that after the lime chamber, lime deposit might grow unequally on the lips of the lower trays, as may be the case in the extremely ingeniously devised Grüneberg still, but I understand the flow is found to be so rapid that deposit does not take place at all. Seventy tons sulphate have been made in one saturator in 94 hours, at the rate of about a quarter of a hundredweight per minute. Economy of fuel is claimed, and the loss of ammonia, under 0·02 per cent., is small.

One of the operations scheduled under the Act is the use of gas liquor "in any manufacturing operation." To obtain a supply of caustic ammonia cheaply for the purpose of removing impurities from the crude illuminating gas has been the aim of many chemists and gasworks engineers. Mr. Thomas Holgate, engineer and manager of the Halifax Corporation gasworks, has devised and patented an arrangement in which exhaust steam from various pumps and engines gives all the heat required for the preparation of caustic ammonia in solution from gas liquor. I will let him describe it in his own words. He writes:—

"The plant consists of (1st) a rectangular vessel 6 feet square × 22 feet in height, into which the waste gases from the sulphate of ammonia saturator are passed. Within this vessel is fixed a coil of 2-inch tubes through which flows unpurified ammoniacal liquor. Entering cold at the base of the vessel it emerges at the top at a temperature of 200° F. into a vessel 6 feet × 6 feet × 4 feet 6 ins. deep, forming a continuation of the vessel referred to. Inside this prolongation the heated liquor passes over trays for the purpose of assisting the liberation of the SH_2 and CO_2 (which pass by a pipe into the saturator) and thence passes in a caustic state to a separate vessel now to be described. (2nd.) This vessel is 9 feet high × 6 feet square, and receives, as already stated, hot purified liquor from the upper part of the vessel No. 1. Inside this vessel No. 2 is fixed a coil of 2-inch wrought-iron tubes through which flows a second stream of cold unpurified ammoniacal liquor. The object of this arrangement is to raise the temperature of this second stream of unpurified liquor by the heat contained in the purified liquor which is being passed to the gas washer. The unpurified liquor then flows from vessel No. 2 to vessel No. 1 as already described for the 1st stream. The operation is automatic and without any cost whatever except interest upon the capital and maintenance of the plant. The action of the purified liquor upon the coal gas is very beneficial and the smaller number of changes of purifiers is very marked; as also is the increased production of sulphur in the Claus kiln."

The proportion of gas liquor purified is about four times the portion that goes into sulphate of ammonia (*i.e.*, the natural make from the coal) and Mr. Holgate is of opinion that he has obtained about four times the average yield of sulphur in the Claus kiln from the addition of the liquor-desulphurising plant. To reduce materially the number of changes of purifiers reduces in like measure the nuisance and loss attendant on such changes.

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TABLE showing the TOTAL ACIDITY in terms of SO^3, of GASES leaving CONDENSERS for re-oxidising NITROGEN OXIDES to NITROUS and NITRIC ACIDS.

Register Number of Works.	Grains SO^3 per Cubic Foot	
	Nitric Acid and Nitrate of Iron Works.	Arsenic Acid Works.
1077	0·22	—
1118	3·88	—
1147	0·62	0·80
1161	—	0·79
1198	0·95	—
1254	—	0·11
Average -	1·42	0·57

I have separated in the above table the tests of works engaged in the manufacture of arsenic acid and arseniate of soda, where the exits could be tested, but in the case of three of the seven arsenic works, the nitrogen oxides evolved form the nitre supply required for the vitriol chambers, and are thus utilised, not regenerated; one work uses both methods; when regenerated fully 96 to 98 per cent. is recovered in a form available for use again in the process. In only two cases have opportunity and time been found to test the exit of nitrate of iron condensers. Frequently on my visits the plant is found idle; on other occasions if the chimney when smokeless has been found colourless and with no foxy red fume, I have generally been satisfied hitherto that condensation has been practically complete. Two tests however, one this year and one last, have shown me that re-oxidation may have been effected, but that the condenser has not arrested the fog or mist of regenerated nitric acid, and escapes of 3·88 and 3·40 grains as SO^3 with no smell of nitrous compounds in the aspirated gases prove that the draught on the condensers was too great to allow the particles time to aggregate into drops.

At all the works where nitrate of iron is produced, and the number 45 shows an increase of 4 during the year, provision is made for the recovery of the nitrous compounds evolved. The Lunge-Rohrmann towers, mentioned last year, continue to give great satisfaction. In nitric acid manufacture, a continuous process is a great desideratum, and it is to be hoped Mr. Manning Prentice may be successful enough to induce other manufacturers to follow his lead. The disposal of the resulting sulphate of soda containing so much bisulphate as to flow away readily at the temperature at which the still is worked, cannot be easily effected in a small work, though in the larger works, where it can be run down with salt in a salt cake pot and be used for evolving hydrochloric acid, this plan of running off in liquid form has been for many years in use, local escapes being much minimised thereby.

Promising attempts have been made at one works in modifying the form of receivers from the old Woulfe's bottle type, and so lessening the

District No. 4—*continued.*

escape at joints by reducing the number of receivers required and giving much more surface in the latter. As the method is the subject of a patent and is one of very recent introduction in this district, more need not be said than that the results so far are distinctly encouraging, though the material chosen for the receivers—glazed stoneware—is certainly not the right one.

Wool Carbonising or Fibre Separation Works.

Table showing the Acidity of Gases leaving the exits of Condensers.

Register Number of Work.	Grains HCl per cubic Foot.	Total Acids in terms of SO^3 per cubic Foot.	Register Number of Work.	Grains HCl per cubic Foot.	Total Acids in terms of SO^3 per cubic Foot.
		Grains.			Grains.
1060	0·055	—	1217	0·800	1·50
1074	0·023	—	1221	0·030	—
1084	0·020	0·32	1224	0·030	—
1115*a*	0·107	0·25	1229	0·068	0·12
1115*b*	0·160	—	1239	0·050	0·12
1125	0·020	0·20	1241	0·120	—
1126	0·175	—	1243	0·085	0·40
1128	0·030	0·25	1249	0·020	—
1141	0·022	—	1255*a*	0·090	—
1169	0·040	0·25	1255*b*	0·315	—
1179	0·150	—	1258	0·113	—
1194	0·042	0·10	1265	0·015	—
1216	0·175	—			
Average 1894				0·110	0·35

As the operations conducted in this class of work have been fully described in previous reports, especially in XXX. pp. 71, 72, it is unnecessary to repeat such description, especially as no new form of treatment or of machine has been adopted or introduced during the year. The character of the work varies widely in different works; some only wish to destroy cotton sewing threads so as to guarantee the wool free from cotton, the original amount of which does not exceed 5 per cent.; others, largely of the class known as "Commission carbonisers," deal with rags of cotton warp and woollen or worsted weft, the amount of cotton rising, perhaps, to 60 per cent. The treatment of this latter material requires special attention to prevent escape of acid gases, and the quantity of dust arising from the destruction of the cotton makes the operation a very disagreeable one for all employed. Where also such profound ignorance of even elementary chemistry exists, it is a difficult matter to educate manufacturers to see what is required to deal with the nuisance created by their operations; for instance, at one work I found the condenser choked by cotton dust, and the pipe column stood full of water which overflowed at a defective joint at the outlet pipe, but the manufacturer did not know but that all was right, as long as he saw water coming down he thought he had done all that was needful in the way of attention; only by time and perseverance can a better state of things be arrived at. Unfortunately for the cause of education, moreover, the works treating for removal of cotton threads only are often adjuncts to large mills, whose proprietors, without previous chemical knowledge, very soon realise what is wanted and carry it out efficiently and permanently. The smaller manufacturers dealing with the material

District No. 4—*continued.*

containing high cotton percentage, can with great difficulty be brought to see that they are not being treated with special severity in being required to put up larger condensing apparatus, they have a secret feeling that they are being put upon, while the first named class are quick to point out to me the essential difference between their operations and that of their humbler neighbours.

The table above gives the results of tests made from the gases leaving the condensers; only one was given in last year's report, p. 72, from tests made in works using machines for carbonising, while now I am able to report that at all the 28 fibre separation works, and, of course, at the five works decomposing salt, registered under the old Act, some form of condenser has been erected, and is in operation; the efficiency of all has not yet been tested. In the case of 1,217, whose test of 0·081 grains HCl. increases the total average escape to 0·110 from 0·81 grain HCl per cubic foot, the test was taken when the full supply of HCl gas was entering the machine, which was treating material with much cotton warp, the dust from this was carried forward and was choking the coke, diminishing its efficiency; the proprietors were warned of the necessity of more frequent attention. In another case I have advised the erection of a dust catch-chamber before the condenser similar to that common in manure works. Education is somewhat slow, but I hope progress will be sure. Mention was made of a "dry condenser" last year. The test taken at 1,258 represents the acidity of the escaping gases on the only occasion when a test could be taken; the operations need a little more study, a wet condenser as an alternative piece of plant seems necessary, as the work of the three carbonising machines may not synchronise with that of the dry condenser.

Cement Works.

No change is to be recorded in this class of work, of which only three remain since the diminution in the district last year, except that one of the three has been idle during the entire year.

Bisulphide of Carbon Works.

The number (2) remains the same, and there has been more activity in the manufacture, on the whole, during the last six months. At the larger work pressure has been put upon the proprietor to make more adequate provision for the final gases, but he is extremely slow to move; lacking technical knowledge he is timid at taking any fresh step, more especially as the first step taken resulted in such loss of carbon bisulphide that it had to be abandoned; the apparatus was put under slight suction at the condenser end to minimise, if possible, the escape of vapour from the retorts, with its attendant dangers at charging time: I do not yet see my way to prevent this easily; to put on such draught that air would be drawn in would be a very dangerous proceeding. After charging is completed the gases can be forced by the pressure of the apparatus over or through lime or oxide of iron.

Arsenic Works.

The consideration of this class has been already chiefly taken under the head of nitric acid works; the bulk of the operations consisting in the conversion of arsenious acid into arsenic acid or arseniates. There remains, however, one work in which arsenious acid is recovered from magenta residues. The material made into bricks with coke dust and lime is charged into a coke fired cupola furnace and the volatilised arsenious acid caught in a long series of chambers. As the recovery process is only rarely in operation, opportunity did not offer until towards the close of the year to test the escape. While, as might be expected from the above description, the total acidity as SO_3 is low, the escaping arsenious acid amounted on the average to 0·31 grain per cubic foot, maximum 0·38 grain per cubic foot; these tests were made for me by

District No. 4—*continued.*

Mr. E. M. Fletcher. I have advised the insertion of a layer of gorse or broom in the last chamber; as there is so little SO_2, perhaps heather would last for some time as the first two are not to be easily procured.

Tar Works.

The number of works now scheduled for this operation is 38, being an increase of three during the year; of these, 17 are works requiring registration under the Act of 1892, *i.e.*, no other scheduled operation is carried on, and it is in the new works I have experienced the greater difficulties in obtaining efficiency, in two cases a time limit had to be insisted on for the satisfactory completion of the works promised, or prosecution would have to follow.

At the close of the year only three works remain, all single still works, in which no provision is completed for dealing with the gases from the still worm ends. The chief of these three, the other two working very intermittently, is a very peculiar case, where the problem is by no means simple. The tar treated comes from a set of Simon-Carvés ovens and contains a large quantity of water, and also of naphthalene. The still is filled up three or four times before working on to pitch; this is to get rid of the water and obtain sufficient hydro-carbons and pitch to conclude the round of operations. During the later stages great care has to be exercised as naphthalene crystallizes in such quantity that ready access to the worm end is essential. I have discussed the matter with the proprietor, and we have agreed upon the form of receiver to be adopted.

A little misunderstanding arose last year among some tar distillers on receiving the preliminary circular from the chief inspector as to the necessity of trapping the gases from the worm end of the still; they imagined the adoption of the swan-neck was compulsory, and I found it very widely introduced during 1893; in many cases it was not willingly adopted, as the drawbacks were the necessity of clearing and emptying the greasy contents of the swan-neck at the close of each operation, so as not to contaminate the light oils, &c., of the first distillate in the succeeding charge, and it was not felt that the still-man would always attend to this duty. On learning from further experience that Act requirements would be fully carried out if the receiver was closed and maintained under suction, many distillers have reverted to the straight worm end joining directly to the receiver, which should be of considerable size, to allow for a boil over, an accident that cannot always be prevented. I desire again to accentuate the necessity of having means for a physical separation of every still in a group, to be made when the still is out for cleaning, a blank flange to be inserted in the gas draught-pipe from receiver or swan-neck so as to prevent possibility of such mishap as the failure to turn a tap might produce for those engaged inside the still if the exhausts were to be stopped by chance. The advantages gained by placing the pitch receiver under suction during the time that the pitch is being run off from the stills (perhaps being softened at the same time), and for some hours after, have been very manifest where it has been adopted for the first time at my suggestion; it is this portion of the apparatus that has to bear the greatest strain. When constructed of wrought-iron an old boiler is sometimes used. The strain on the rivets on running in the hot pitch into a cold receiver is very considerable, repeated as this is from day to day, and the placing the whole receiver under slight suction serves to lessen the pressure on the top surface, and condensable vapours that would otherwise escape are recovered in the process, together with a not inconsiderable amount of permanent gases that have a distinct value for heating purposes if taken to the steam boiler fires. More detail on this subject is contained in last year's report. As regards methods of dealing with the foul gases in the 38 works, 27 burn the gases, preferably in the steam boiler fires (I cannot recommend the still fires, for these are drawn at the close of the operation, before the splitting up of thio-compounds in the final anthracene stage is completed), four absorb in oxide of iron, two in lime, and two in milk of lime or lime-water, three only have as yet

District No. 4—*continued.*

no method complete. In the case of the largest tar work I have tested the gases after combustion and never found a trace of sulphuretted hydrogen, and the average total acidity as SO_3 was only 0·29 grains per cubic foot from the steam boiler and tar still fires, maximum 0·41 grains. Many use heavy oil seals for washing the gases before being further dealt with; in one case the gases pass with those from the sulphate of ammonia plant to oxide purifiers, and as much air was drawn in by the exhauster at the tar plant a slight explosion occurred at No. 1 purifier.

R. Forbes Carpenter.

Prestwich, January 28, 1895.

District No. 5.—South Midland.

Edward Jackson, Esq., F.I.C., F.C.S.

The number of works registered =

9	alkali works.
157	scheduled and other works.
Total - 166	

The following are the separate processes under inspection :—

3	alkali works.
4	hydrochloric acid (cylinder) works.
3	hydrochloric acid (waste pickle recovery) works.
2	copper works.
26	sulphuric acid works.
46	chemical manure works.
2	gas liquor works.
2	muriate of ammonia works.
23	tar works.
69	sulphate of ammonia works.
2	chlorine works.
8	cement works.
8	salt works.
7	sulphur recovery.
18	nitric acid works.
7	nitrate of iron works.
4	Venetian red works.
Total - 234	

Seven additional works have been added to the register this year :—

3	for the manufacture of sulphate of ammonia.
2	,, ,, salt.
1	,, ,, chemical manure.
1	,, ,, chlorine.

The following works have been closed :—

No. 1551 - - - - - chemical manure.
,, 1524 - - - - - sulphate of ammonia.

There has been a net increase of five works for the year.

The average escape of hydrochloric acid per cubic foot in alkali and copper works = 0·098 grain, and the amount escaping compared with that produced = 2·53 per cent. in alkali works.

The total acids in one cubic foot of chimney gases = 0·62 grain as SO_3.

In the sulphuric acid and alkali works the average escape from the chambers into the chimney = 1·63 grains as SO_3 per cubic foot.

In the chemical manure works the average of the tests made of the acid gases escaping into the chimney during the manufacture of superphosphate = 0·28 grain, total acids as SO_3 per cubic foot, and the percentage condensed from the same shows 88·7 per cent. of that generated.

District No. 5—*continued.*

The average of the tests made of the smoke escaping from the chimneys of salt works = 0·044 grain total chlorine as HCl, and 0·33 grain total acids as SO_3 per cubic foot.

Alkali and Copper Works.

The number of alkali works on the register = 9.

I am glad to be able to report that, with two exceptions, at one work, no chimney test has reached Act limits. The exception being at work No. 1500 (copper work), specially referred to below. Both infringements were due to chlorine.

There is not much of special interest to note at the works this year.

No. 1437. Another fine block of condensers has been erected, and is now practically completed, though not connected to the furnaces. They are much the same in structure to those referred to in last year's report. Of the 37 tests made here during the year of the chimneys and vitriol chamber exits, not one has reached Act limits.

No. 1463. There is a good record of tests to report here during the year. The maximum HCl escape = 0·14 grains, minimum 0·05. Chamber exits, maximum = 2·00 grains (one test only), next highest = 0·70 grains, minimum = 0·20 grains total acids as SO_3 per cubic foot.

No. 1500. The condensation here has been more satisfactory this year, the escape of hydrochloric acid in the chimney consequently more regular, and, with two exceptions, has never reached Act limits. The average for the year = 0·15 grains. For the previous year (1893) it was 0·16 grains. In 1892 = 0·18 grains per cubic foot. Seventeen visits have been made to this work, and 34 tests of the chimney gases have been taken.

Alkali and Copper Works.

Giving the Averages of the Tests made during the year.

Register Number.	Number of Chimney.	Total Acids in One Cubic Foot of Chimney Gases as SO_3.	Hydrochloric Acid in One Cubic Foot of Chimney Gases.	Number of Vitriol Chamber Exit.	Total Acidity of Gases escaping from Vitriol Chambers, as SO_3 per Cubic Foot.
		Grains.	Grains.		Grains.
1463	1	0·50	0·11	1	0·45
				2	0·93
	2	0·50	0·07	3	0·48
				4	0·20
1437	1	0·60	0·09	1	0·97
	2	0·30	0·04	2	0·50
	3	0·75	0·11	3	0·07
	4	0·50	0·06	4	2·10
				5	1·47
1477	1	0·44	0·12	Copper works.	
	2	0·63	0·13		
1500	—	1·34	0·15		
1468	—	Cylinder works.		—	1·73
1483	—	—	—	—	1·82
Averages	1894	0·62	0·098	—	1·07
	1893	0·64	0·100	—	1·13

District No. 5—*continued.*

SULPHURIC ACID WORKS, INCLUDING ALKALI WORKS,

Giving the Averages of the Tests made.

Register Number.	O.V. Exit. Total Acidity as Grains SO_3 per Cubic Foot.				Average for Year.	Remarks.	Average for previous Year.
	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.			
1416	0·80	3·85	0·70	1·15	1·63	Small plant has to be very carefully watched, as slight alterations quickly effect the escape.	1·30
1417	0·80	0·70	2·60	0·80	1·23	Carefully worked. The somewhat high figure for 3rd quarter was due to test taken before chambers were in settled work after stoppage.	0·65
1429	0·70	0·25	1·00	0·50	0·61	——	1·07
1431	3·30	1·60	3·80	1·90	2·65	This is a small plant, and the remarks on No. 1416 apply equally here.	2·48
1433	0·83	0·80	—	—	0·82	The plant has remained idle here since June.	0·72
1455	2·40	3·40	—	2·10	2·63	Three out of the four chambers have been entirely rebuilt this year.	0·87
1460	2·40	6·20	3·85	2·05	3·63	The steady working of the chambers has been adversely affected by bad quality of spent oxide frequently obtained, although it is all now washed before used. That burnt recently has been better.	1·30
1465	3·50	3·70	1·00	1·10	2·33	——	1·60
1471	1·40	2·80	—	5·45	3·22	Chambers largely rebuilt this year. High average for 4th quarter due to test taken a few days after the plant had been restarted	2·62
1468	0·80	3·37	2·05	0·70	1·73	There is perhaps no plant in the district where the burners are worked with so little local escape, and I should like to see more works up to this standard in this respect. One chamber has been rebuilt.	1·04
1478	2·80	2·00	1·50	—	2·10	The burners were largely rebuilt here in the autumn, and the plant generally repaired.	0·60
1588	—	0·60	—	0·40	0·50	Very little work has been done here this year.	0·78
1483	0·60	2·60	2·50	1·57	1·82	The escape has been higher this year than previously, as several alterations have been made with a view to improve the draught on the burners, and so interfered with the usual regularity of working. Continuous tests are taken.	1·05
1472	1·10	—	—	1·60	1·35	——	2·00

District No. 5—*continued.*

Register Number.	O.V. Exit. Total Acidity as Grains SO_3 per Cubic Foot.				Average for Year.	Remarks.	Average for previous Year.
	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.			
1487	0·40	0·55	3·00	0·75	1·18	Pressure has had to be put on here to keep the chambers in better repair. Unusually large chamber space is employed. No tests are taken of exit gases.	0·70
1492	1·10	2·87	1·10	2·40	1·87	Although the average escape is lower than last year, the figure has not yet reached that of previous years, which was obtained under different conditions of working.	3·56
1514	1·00	0·25	0·30	0·50	0·51	Most carefully worked plant, spent oxide and large proportion of H_2S are the sources of sulphur.	1·03
1489	0·50	1·30	0·80	0·50	0·78	A continuous rectifying apparatus has been connected this year to the scrubber attached to the chambers, so that now the exit test measures escape from both sources.	0·62
1454	1·65	—	1·00	0·70	1·12	Additional chamber and denitrating column added this year. The introduction of the H_2S from the ammonia plant into the burners has facilitated the working off of the oxide charges.	2·33
1494	1·90	2·73	2·55	1·81	2·25	As to the general condition of this plant there has been continued improvement and a marked reduction in local escapes. The class of burner employed, by its irregular charging, demands that the greatest watchfulness be kept on the chamber working.	2·58
1421	—	—	—	—	—	Been idle all the year - -	—
1453	2·40	3·40	—	2·10	2·63	A considerable portion of the plant is new. The draught was not, however, quite satisfactory, so the denitrating column was repacked during the summer stoppage.	1·07
1505	2·57	1·45	1·90	1·00	1·73		2·60
1437	1·20	1·43	—	0·88	1·17	Continuous tests on all exits, and very careful and skilled supervision.	1·15
1463	0·27	0·76	—	0·52	0·51	All the O.V. series have been kept well within Act limits, and there is a very good record for the year. Continuous tests made.	0·68
1497	0·52	0·65	0·60	0·54	0·58	The chambers have been worked with commendable regularity. The local escape from burner fronts is still considerable at times, and they require to be rebuilt before the plant can be considered satisfactory.	0·96
Averages - - - -					1·63	- - - -	1·41

District No. 5—*continued.*

Chemical Manure Works Tests.

Register Number.	Weight of Manure discharged into Den at Time Test was taken.	Class of Materials treated at Time of Test.	Remarks as to Draught.	Total Acidity of Gases leaving Mixing Apparatus as SO_3 per Cubic Foot.	Total Acidity of Gases leaving Condensing Apparatus as SO_3 per Cubic Foot.	Amount of Acid condensed compared with that produced.
	Tons.			Grains.	Grains.	Per cent.
1481	18	Bones and coprolites	Chimney	0·60	0·20	66·6
1453	10	American and Somme	Fans	17·00	0·30	98·3
1455	80	Belgian, Florida, and bones.	Fans	4·20	0·30	92·8
1485	15	Florida and shoddy	Chimney	13·00	0·30	97·7
1478	1	Belgian and shoddy	Chimney	—	0·30	—
1417	28	Belgian	Fans	2·50	0·30	88·0
Averages					0·28	88·7

Nitric Acid Works.

No additional works of this class have been registered this year. At Work No. 1576, where nitrate of iron is manufactured, the nitric acid for which is brought into the work from another factory, therefore only coming within the scope of the Act in consequence of the amendment of 1892, condensers for absorbing the nitrous gases have now been erected. Formerly these gases escaped into the chimney.

Cement Works.

There has been practically no change to report in the eight cement works in this district, either as to increase, class of materials used, or method of treatment.

Chlorine Works.

In addition to the Weldon and Pechiney chlorine processes in operation in the district, a new plant, around which a great amount of interest centres, has been erected at the works of the Aluminium Company at Oldbury, for the manufacture of caustic soda and chlorine electrolytically from brine by Castner's patents. Practically pure caustic soda is produced, and chlorine of 95 to 97 per cent. purity obtained, which is free from hypochlorites, the remainder being hydrogen. The main features of Mr. Castner's process may be thus briefly described as being the use of a moving body of mercury, which completely separates and so prevents any recombination of the products of the electrolysis. It also supersedes the use of a diaphragm, the sodium amalgam formed being decomposed at once. The cell is rocked so as to give motion to the mercury. As will be realized, the necessary movement to keep the mercury in motion is very slight. The actual movement of the cells is communicated by excentrics fixed on a long shaft, so as to cause the cells to rise and fall $\frac{1}{8}$th of an inch above and below the level twice a minute. This movement is quite sufficient to cause the mercury to flow completely from side to side

District No. 5—*continued.*

There are three compartments in the cell, the two outside ones contain the salt solution with the carbons, the middle compartment contains an iron cathode and the caustic solution. The salt solution circulates continuously, and is being continually electrolysed. The chlorine escapes by a suitable pipe from each cell to the main leading to the absorbers. The sodium amalgam produced is decomposed when it reaches the middle portion of the cell, and the caustic solution flows away by a suitable pipe. A known quantity of water is admitted from time to time, which causes the caustic solution to overflow. The cells are connected in series, and mains run along the side of the cells to convey away the different products, and bring the brine to be decomposed. As the whole rocking movement is so very slight, by making a short bend in the branch pipe to each cell from the mains, it amply provides for rigid cell connections. There is no difficulty in keeping all the cell covers and pipe connections gas tight. The house in which the cells are placed has, up to the present, been found singularly free from local chlorine escapes. The process is continuous and automatic. As no hypochlorites are formed, there is not the decrease in electrical efficiency, as has been the case in some previous electrolytic processes, when these compounds have been produced, and so the wear on the carbon anodes, which are specially prepared, is very slight. Some of the carbons have been in use now over three months and there is hardly any appreciable depreciation.

Each cell is 6 ft. long × 3 ft. wide × 6 ins. deep, decomposes 56½ lbs. salt daily, and contains 180 lbs. of mercury.

Thirty cells, worked in two series of 15, have now been erected, and 28 are in regular work, two being always kept in readiness in case of a necessary stoppage and disconnection for cleaning of one in the series, which has to be done once in three weeks. Prior to this 14 cells only were in use.

The 30-cell plant produces 1,200 lbs. pure caustic soda per 24 hours, and a corresponding quantity of chlorine. At present the chlorine is being used for the manufacture of potassium chlorate.

Mr. Castner informs me that increased experience with the working of the enlarged plant has fully confirmed all previous figures that have been made public as to the process.

Through the courtesy of the managers of the company I am enabled to give the following information and figures concerning the process up to the present date:—

"During the time it has been in work about 34 tons of caustic soda have been produced, testing 78/9 Liverpool test.

"The plant was started in sections, and worked intermittently at first, in order to accustom the men to the new work, so that later periods are more favourable for observation. During 91 days continuous running of 14 cells, with an expenditure of 4,540 I.H.P., there was produced 23·05 tons caustic. This corresponds to 33·67 tons pure salt decomposed, and an evolution of 20·4 tons chlorine. The foregoing is equal to an average daily expenditure of 49·9 I.H.P., and each I.H.P. decomposed daily 16·6 lbs. pure dry salt = 18·8 lbs. of ordinary salt. No attempt was made to measure the actual amount of chlorine given off, although for convenience this was converted into potassium chlorate, but as dry salt is electrolysed only, and the solution flowing through the cells remains the same during the whole time, it is evident that the chlorine can be easily determined with certainty.

"As to the loss of mercury, this is very slight, and our observations convince us that now the men have got into the work, and in continuous running, the loss will not exceed our original estimate of 5 per cent. per annum."

District No. 5—*continued.*

Salt Works.

Tests made of Chimney Gases.

Register Number.	Number of Chimney from which Test was taken.	Total Acids as SO_3 per Cubic Foot of Smoke.	Total Chlorine as HCl per Cubic Foot of Smoke.
		Grains.	Grains.
1516	1 (C.B.)	0·10	·03
,,	2 ,,	0·10	·03
,,	3 ,,	0·20	·04
,,	4 ,,	0·20	·02
,,	2 (Town)	0·10	·03
,,	28 ,,	0·20	·03
,,	29 ,,	0·50	·04
,,	31 ,,	0·50	·03
,,	48 ,,	0·60	·02
1442	1	0·20	·03
,,	4 (B.)	0·30	·04
,,	4 (R.)	0·10	·02
,,	6	0·90	·10
,,	9	1·00	·18
,,	13	0·50	·04
,,	17	0·30	·02
,,	1, 2, 3, 4, 5	0·40	·04
1439	1	0·20	·06
1491	1	0·10	·05
1518	—	0·10	·06
1570	—	0·40	·02
Average - -	- - -	0·33	·044

Gas Liquor, Sulphate of Ammonia, and Muriate of Ammonia Works.

There are 71 works on the register this year for the manufacture of sulphate of ammonia, muriate of ammonia, and the concentration of gas liquor.

One sulphate of ammonia plant has been stopped during the year, and three additional works have been registered.

In some works the purifiers have been found occasionally out of order, but the defects were at once remedied. This has occurred either where new oxide has been used in the purifiers, or where it has been nearly spent.

It is extremely important that the purifier walls should be very carefully built. The bricks, preferably "Staffordshire Blue Bricks," should be well laid in cement, and a cement lining inside is often necessary. Where these precautions have been neglected, in a very short time the noxious gases have come through the joints in the brickwork. This has taken place in one or two new works, so that it has been necessary to stop the work and rebuild. In two cases an outer wall was built round the existing purifier, and a space left between the old wall and the new, which was filled in with Portland cement. Hard pitch can also be used in a similar way with satisfactory results. Iron purifying vessels are more durable, and are in use in some works, but brickwork, if well constructed, can be made quite gastight.

The cost of emptying the oxide purifiers varies considerably. It is less with the continuous process; and the cost for labour, where it has been ascertained, in one or two places amounts to about 1*s.* per ton on the

District No. 5—*continued.*

sulphate of ammonia produced. By the intermittent plan as much as 3*s.* in one work, is the cost.

Revivification in *situ* would considerably reduce this figure.

In 34 works, representing 92·5 per cent. of the liquor distilled in the district, continuous stills are used, while at 14, with four exceptions, all small works, the intermittent plant is employed.

In 48 works, where 33·9 per cent. of the liquor is distilled, the oxide of iron purifier is in use for arresting the sulphuretted hydrogen.

In nine works, where 40·2 per cent. of the liquor in the district is distilled, the sulphuretted hydrogen is burnt for the production of sulphuric acid.

At two works both lime and oxide of iron are used in the purifiers.

At one work lime alone is used.

In four works the liquor does not contain sulphide of ammonium, and, consequently, no sulphuretted hydrogen is discharged.

In five works, representing 15·6 per cent. of the liquor distilled, the sulphuretted hydrogen is treated by the Claus process. The average amount of sulphur recovered by this plan per ton of sulphate of ammonia = 77 lbs.

The question as to the disposal of the spent ammonia liquor has received increasing attention in the Midlands this year. The difficulties in the way of satisfactorily purifying the alkaline liquor have caused the stopping of some works. The elimination of the devil's water, which can be returned, either to the ammonia still or used again in the scrubbers, has not, in all cases been sufficient. Several years ago Mr. Belton, the engineer and manager of the Shrewsbury Gas Company, had to face this question, and for a period the sulphate manufacture had to be stopped. Experiments were undertaken, in conjunction with Messrs. Davis Bros., of Manchester, with a view to the disposal of the spent liquor in some satisfactory manner by evaporation, which would render the steam from the evaporating vessel innoxious when discharged into the air, and so permit of the manufacture being resumed. Some of the special advantages claimed by this process, as will be seen, are in connexion with coal gas manufacture and sulphate of ammonia plants attached to gasworks. The quantity of liquor to be evaporated is reduced by returning the spent liquor to the scrubbers, after evaporating the surplus water. A fresh amount of alkali is added to this liquor on its return to the scrubbers, to make up for loss, mainly by decomposition, referred to below. The process may be shortly described thus:—

An alkaline solution, made up of carbonate of soda, is used on the last scrubber instead of water. This mixes with the ammoniacal liquor which is used in the other scrubbers, and some is taken away as required for the sulphate of ammonia manufacture. Instead of lime more carbonate of soda is used in the still, and as the ammonia is mostly in the form of carbonate and sulphide it is quickly liberated from the liquor, passing to the salinators in the usual way, the sulphuretted hydrogen, after separating the steam, being absorbed in oxide of iron. The spent liquor is pumped into a large covered pan fixed on the top of a coke fired furnace, into which the offensive steam is passed. At the back of the fire is arranged pigeon-holed brickwork, which offers a highly heated surface to the vapours. A portion of the surplus water is here evaporated. Part of the liquor from the pan is returned, after mixing with more carbonate of soda, to the scrubbers. Another portion is run into a second pan, where evaporation is continued up to a point sufficiently far to crystallize the common salt that accumulates. The steam from this evaporator also passes into the destructor furnace. The mother liquor contains of sulphocyanides about 14·4 per cent., sulphocyanide of ammonia; of this ¾ gallons is obtained per ton of coal carbonised. This liquor at the present time is being sold at what is considered a satisfactory price for the purpose of being worked up into a marketable product. The accumu-

District No. 5—*continued.*

lation of common salt in the liquor is an interesting feature; as 58 per cent. soda ash is used, the bulk cannot be derived from this source, so that it must come from the chlorine in the coal. As to this point, Mr. Carpenter's experiments, see XXIXth Report, page 74, afford corroborative testimony. Mr. Belton, by the new apparatus, shows a very largely increased yield of ammonia, over the one previously used. This is being made the subject of experiment with a view to obtaining a more complete explanation than has hitherto been possible, with the comparatively short time that has been available for investigations in this direction. It will be interesting to see if any further developments occur in the other works where the process is about to be started.

It is estimated that 15 gallons of water are produced during carbonization per ton of coal, and that 10 gallons of water were introduced originally to the scrubbers per ton of coal, so that the latter is now saved to the cost of evaporation.

At work No. 1532 the copper saturator has been in use now three years and eight months, and the only repair necessary has been the fixing of four new rivets. It is still in a most efficient condition.

Among some improvements the following may be mentioned.

At work No. 1497, two new saturators have been built, and the condensers completely rearranged and improved, also two new stills have been put in.

No. 1432, larger oxide purifiers have been built.

No. 1465, the condensing arrangements have been considerably increased this year.

No. 1478, an improved condenser has been attached.

No. 1562, an entirely new purifying plant has been erected.

Three new plants have been registered, and are all supplied with condensers, and oxide of iron purifiers.

The carbonising works have been kept fairly busy this year. A small additional work of this class has been added to the register.

Tar Works.

The number of tar works in the district remains the same as last year, viz., 23.

In 12 works the worm ends from the stills are finished with bends or "swan necks," and in six the worm ends are connected to receivers and separators, which are kept under suction. In three cases the suction is produced by means of a pump, and steam jets in the remainder. The pressure of still, with "swan neck" end, is relied on to force the gases forward to the purifying apparatus in three plants.

In six works the noxious gases from the stills are arrested in oxide of iron, and in three of these, both small works, no intermediate condensers or scrubbers are used. In the fourth, No. 1544, with eight stills, the gases travel through iron pipe condensers, and thence into coke scrubbers, down which water flows, before entering the bed of oxide. No. 1469, coke scrubber is fixed between still and purifiers. At the remaining work, No. 1472, where oxide of iron is employed, the gases pass up an oil scrubber on their way to the purifier. As to oil scrubbers, at work No. 1574 one of sufficient dimensions is used, together with a battery of condensers, whereby the noxious gases are completely arrested. A powerful pump is employed to overcome the resistance of the large scrubber.

At 11 works the combustion method of dealing with the gases, by passing into a suitable fire, has been adapted. The importance of water seal between still and place of combustion was shown at work No. 1465, where the gases fired back, and the explosion that occurred completely destroyed the seal box.

District No. 5—*continued.*

At 1535, where iron works tar is distilled, the worm ends have been finished with the "swan neck," and the arrangements are now complete for connecting to "the green gas main" at the first opportunity. This cannot be carried out until the plant is stopped.

At the three works referred to in last year's report, where the requirements of the Act as to the treatment of the still gases had not been complied with, the necessary connections have now been made. No. 1513, very small plant with two stills, an oxide purifier has been attached. No. 1581, gases are burnt. No. 1582, steam injector, with water seal, has been attached, and the gases are also burnt.

In three works, where "prepared tar" only is manufactured, one still at each work, the worm ends have not yet been trapped. The stills at these works are only used occasionally. There is also one small plant where bone tar is distilled.

There are two points in the distillation where the worm end gases are offensive—at the beginning of the operation, when sulphide of ammonium distils over, and especially at the later period, when the anthracene is coming over. In the Midlands I find a common practice prevails of not putting the exhaust on while the naphthas come through, but it is turned on when the heavy oil commences. This is left to the judgment of the still man; frequently I have found that he has delayed rather too long the application of the suction. The objection made by some tar distillers to keeping the pump or steam jet on from start to finish is that they fear some of the lighter products may be drawn away, and so loss occur. This difficulty, if it really is not imaginary, could be met by interposing an oil scrubber between still and exhauster, as is already done in two works. By keeping suction on during the entire period of the distillation, it would conduce to a much safer plan of working, by considerably minimising the chances of occasional offensive emissions from such works.

The French Pitch Cooler, at work No. 1472, has been increased in size, so that the cooler accommodation is now in a most satisfactory working proportion to still power.

The pitch cooling arrangements are far from satisfactory at work No. 1582. The uncertainty as to the continuance of the manufacture here has been given as the reason for delay with the required improvements.

At the works generally more attention has been given to the running off of the pitch, and allowing it to remain as long as practicable in the cooling vessels.

There are four works, Nos. 1544, 1469, 1472 and 1586, worthy of special notice, and where, I am glad to be able to report that the plants leave very little to be desired in the arrangements for dealing with the noxious gases given off during the manufacture. Especially in two cases no pains or expenditure of capital have been spared to make the apparatus as efficient as possible in this direction.

Muriatic Acid (other than Alkali) Works.

Three out of the four furnaces erected in the district for the recovery of hydrochloric acid from the waste pickle at galvanising works have been in continuous operation. The local escapes, through cracked pipes, leading from furnaces to condensers, have been the chief source of anxiety, and I have frequently had to call attention to this point. With regard to the condensation of HCl there is not much difficulty when 15° F. acid is produced, but chlorine has twice been observed in the gases leaving the condensers. This is doubtless due to catalytic action, hydrochloric acid and ferric oxide. The average of the tests made = 0·18 grains hydrochloric acid per cubic foot of smoke.

District No. 5—*continued.*

The following table gives some of the tests made:—

Register Number.	Date.	No. of Furnace.	Hydrochloric Acid per Cubic Foot escaping.	Remarks.
			Grains.	
1577	Jan. 30		0·12	
„	May 1		0·15	
„	Aug. 31		0·18	
„	Nov. 27		0·18	
1579	Jan. 24	I.	0·09	
		II.	0·16	
„	June 11	I.	0·22	Furnace over pressed as No. II. was out for repair. Total acidity of gases, 0·35 grains per cubic foot.
		II.	Stopped.	
„	Sept. 12	I.	0·55	First test - Due to chlorine. See above.
			0·53	Second test
		II.	0·18	
„	„ 13	I.	0·12	
		II.	0·06	
„	Dec. 9		0·13	Both furnaces now connected to one chimney.

Venetian Red Works.

There are four works registered for the roasting of copperas two are only small plants, and have not been very active.

At work No. 1573 the condenser has now been packed with limestone, with the result that 50 per cent. of the acid was found to be arrested in the tower, when the roasting of copperas was at such a stage that a large amount of sulphur acids were given off. More limestone is evidently required, and some arrangement for improving the draught, to compensate for the check caused by the additional obstruction, will be necessary. Probably a steam jet will do all that is needed in this direction.

Tests made of gases escaping from open kilns after packing tower with limestone. Kiln in this instance had been lighted 46 hours, fires drawn after 70 hours—

	Grains per cubic foot.
Total acidity of gases leaving kiln - -	= 45·0 as SO_3
Total acidity of gases leaving limestone tower -	= 22·1 as SO_3
Total acidity of chimney gases - - -	= 2·1 as SO_3

Before packing this tower with limestone, the water shower only removed 27 per cent of the acid.

No. 1571. I regret that I have to report that practically no further progress has yet been made towards reducing the large quantity of acid gases escaping at this work. A portion of the sulphur acids are partially wasted with water in coke packed towers. The proprietors have now decided, after considering other plans, to endeavour to arrest the sulphuric acid, and some of the sulphurous, in usual coke packed towers by means of water, the remaining sulphurous acid to be passed into a limestone tower or milk of lime washer. This, if properly carried out, should do all that is required, and I hope that no further delay will be experienced.

Where limestone is employed for arresting the sulphur acids in copperas roasting it appears necessary to remove the sulphuric acid first, as far as practicable, by means of a water shower, and so prevent the formation of

District No. 5—*continued.*

sulphate of lime, which would result if the fumes were passed direct into the limestone tower, or milk of lime washer, and which would tend to block the draught, the sulphite of lime resulting from the action of the sulphurous acid on the limestone being a soluble salt.

TABLE showing the AMOUNT of ACID VAPOURS escaping in the CHIMNEYS at VENETIAN RED WORKS.

Total Acidity of Chimney Gases as SO_3 per Cubic Foot.	Remarks.
Grains.	
2·10	Acidity of gases leaving kiln = 45·0 grains. Acidity of gases leaving condenser = 22·1 grains.
0·30	
2·50	
1·80	
0·30	
3·90	Acidity of gases leaving one kiln = 49·0 grains.
3·30	

Most of the figures are much above the Chief Inspector's limit of 1·00 grain SO_3 per cubic foot of smoke in the chimneys. It is to be hoped that speedy improvement will be shown. In all these chimneys the gases from the kilns or furnaces are considerably diluted with products of combustion.

Application has recently been made for the registration of a new work and the erection of the plant is practically completed. Two ordinary plus-pressure blind roasters have been built, exactly similar to salt-cake furnaces. A condensing tower, 35 ft. high × 6 ft. square, made of Yorkshire flags, with rubber joints in the usual way, has been attached. The tower has been packed with scrap iron; air and steam, with a little water on the top, being introduced for the purpose of arresting the sulphur acids. It will probably be found necessary to supplement this condenser with some further appliance for completely arresting the sulphurous acid, and the proprietors have undertaken to erect such additional apparatus as may be decided upon, as soon as it is shown to be required after the starting of the plant.

EDWARD JACKSON.

Birmingham,
January 1895.

DISTRICT No. 6.—SOUTH-WEST OF ENGLAND AND SOUTH WALES.

A. C. FRYER, Ph.D., M.A.

There were registered in this district during 1894:—

6 alkali (including wet copper) works.
179 other (scheduled) works.

Total 185

District No. 6—*continued.*

The number of separate processes under inspection has been 225, consisting of—

3 alkali works.
1 hydrochloric acid (cylinder) work.
2 copper works (wet process).
35 sulphuric acid works.
36 chemical manure works.
3 nitric acid works.
67 sulphate of ammonia works.
3 muriate of ammonia works.
2 chlorine works.
11 cement works.
4 sulphur recovery.
4 Venetian red works.
1 lead deposit work.
36 arsenic works.
10 tar works.
7 zinc works.

Total 225

The processes above enumerated have been for the most part in regular operation throughout the year, and some 789 visits were paid to the works for the purpose of examining the condition of the various plants, whilst 637 chemical tests have been applied in order to ascertain the quantities of noxious gases escaping into the air.

The following works have ceased to register this year:—

No. 1780 - Sulphuric acid.
„ 1820 - Sulphuric acid.
„ 1872 - Sulphuric acid.
„ 1879 - Ammonium sulphate.
„ 1906 - Chemical manure.
„ 1956 - Arsenic.
„ 1958 - Tar.

New Works.

Five new works have been registered during the year:—

1 for the manufacture of ammonium sulphate.
2 „ „ cement.
2 „ „ arsenic.

In November the southern zone of England was visited by one of the most disastrous floods on record. Scarcely a town or village in the south-western counties escaped, and in the open country the gathering of the waters was almost phenomenal. Cornwall, Devonshire, Wiltshire, Dorset, and Hants suffered severely, and the damage to property was enormous. All operations had to be suspended at the alkali works belonging to the Conham Chemical Company, William Butler and Company's tar and resin manufactory, and Messrs. Stone and Tinson's muriate of ammonia works, on account of the floodings of their premises. Not only the works at Crew's Hole near Bristol, but all chemical works situated in low-lying districts have been inconvenienced, and for a time the floods interfered with their operations.

Alkali and Copper Works.

There are six works, including wet-process copper works, on the register for the year, and 22,287 tons of salt have been decomposed during the 12 months.

District No. 6—*continued.*

The average escape of hydrochloric acid from the chimneys of the alkali and copper works, together with the total acidity of the various vitriol chamber exits attached to these works, are given in the following Table:—

Register Number of Work.	Number of Exit or Chimney.	Total Acidity of Chimney Gases given as SO_3 per Cubic Foot.	Hydrochloric Acid per Cubic Foot of Air escaping.	Relation of Hydrochloric Acid escaping to that produced.	Number of Vitriol Chamber Exit.	Total Acidity of Gases escaping from Vitriol Chambers given as SO_3 per Cubic Foot.
No.	No.	Grains.	Grains.	Per cent.	No.	Grains.
— 1783	1	1·46	0·14	—	1	2·38
					1	1·01
1796	1	1·00	—	—	2	2·19
					3	1·28
					1	0·70
					2	0·46
					3	0·66
					4	0·69
1818	1	0·61	0·08	1·13	5	0·99
					6	1·11
					7	0·67
					8	0·50
					1	1·43
1835	1	1·39	0·21	1·14	2	2·46
	1	0·39	0·04	—	1	1·05
	2	—	0·12	—	—	—
1847	3	—	0·08	—	—	—
	4	—	0·03	—	—	—
1853	1	1·23	0·14	—	—	—
Averages	—	1·01	0·09	1·14	—	1·17

Sulphuric Acid Works.

Giving the Averages of the Tests made throughout the year.

Register Number or Work.	Number of Exit.	O.V. Exit. Total Acidity as Grains SO_3 per Cubic Foot.	Remarks.
No.	No.	Grains.	
1770	1	0·68	Plant well watched; daily tests taken.
1773	1	0·98	The year's tests have been entirely satisfactory.
1774	1	1·94	The recorded tests throughout the year have been satisfactory.
	2	1·52	
	3	0·78	

District No. 6—*continued.*

Register Number of Work.	Number of Exit.	O.V. Exit. Total Acidity as Grains SO_3 per Cubic Foot.	Remarks.
No.	No.	Grains.	
1778	1	2·53	This figure should be lower. Chamber space rather small.
1779	1	1·26	The year's record shows improvement.
1783	1	2·38	Sixteen new pyrite kilns and one O.V. chamber have been erected.
1784	1	2·43	Some trouble was experienced with No. 3 O.V. set of chambers during the severe gales in October.
	2	2·38	
	3	2·91	
1796	1	1·01	Thirty-two new pyrites kilns and one O.V. chamber have been erected.
	2	2·19	
	3	1·28	
1798	1	0·77	The year's tests have been entirely satisfactory.
	2	1·17	
1799	1	1·92	This plant has only been in operation for a few weeks during the year.
	2	1·33	
1801	1	3·25	It is hoped that in future the escapes will be more satisfactory, as new Glover and Gay-Lussac towers have been erected.
1808	1	1·82	Glover and Gay-Lussac towers have been erected for No. 1 set of O.V. chambers.
	2	2·02	
1809	1	2·37	One new O.V. chamber has been erected.
1813	1	0·48	The chambers are worked with commendable regularity.
1816	1	1·52	This plant has only been in operation for a portion of the year.
1818	1	0·70	This plant has been maintained in a high state of efficiency, and 66 per cent. of the recorded tests were under 1·00 grain of total acidity as SO_3 per cubic foot.
	2	0·46	
	3	0·66	
	4	0·69	
	5	0·99	
	6	1·11	
	7	0·67	
	8	0·50	
1821	1	2·90	New Glover and Gay-Lussac towers have been erected.
1824	1	1·31	One new O.V. chamber has been erected.
1828	1	1·03	This plant has been maintained in a high state of efficiency.
1831	1	0·49	The tests throughout the year have been most satisfactory. Maximum, 0·75; minimum, 0·20.
1835	1	1·43	The year's working has not been entirely satisfactory.
	2	2·46	
1843	1	1·05	Maximum, 1·20; minimum, 0·80.
1844	1	0·44	This plant has been maintained in a high state of efficiency, and all the recorded tests have been under one grain of total acidity as SO_3 per cubic foot.

District No. 6—*continued.*

Register Number of Work.	Number of Exit.	O.V. Exit. Total Acidity as Grains SO_3 per Cubic Foot.	Remarks.
No.	No.	Grains.	
1845	1	1·90	Two O.V. chambers and a Guy-Lussac tower have been re-erected.
1846	1	1·49	Maximum, 2·20; minimum, 0·50.
1847	1	0·55	The recorded tests are most satisfactory.
1852	1	1·20	Repairs have been heavy at this plant.
1861	1	2·11	The average is higher than in previous years.
1874	1	2·26	Maximum, 2·40; minimum, 0·90.
1878	1	0·83	One O.V. chamber re-erected.
1891	1	1·15	Repairs have been heavy at this plant.
1893	1	2·08	Some trouble was experienced at these O.V. chambers during the severe gales in October.
	2	2·60	
	3	2·99	
	4	3·05	
1894	1	0·34	An excellent average figure, and recorded tests entirely satisfactory.
1918	1	1·21	The year's record shows improvement. Maximum, 1·40; minimum, 0·90.
Average -	—	1·52	

Chance's continuous process for rectifying sulphuric acid is made use of at many works in this district. Levinstein's process is, however, now in operation at No. 1838.

The following Table shows the amount of acid escaping from sulphuric acid rectifying condensers. The figures represent the average of tests made throughout the year :—

Register Number of Work.	No. of Exit.	Grains SO_3 per Cubic Foot.
1774	1	1·34
1778	1	0·50
1779	1	1·13
	2	0·50
1784	1	1·08
	2	1·20
1787	1	0·35
1796	1	0·49
1798	1	0·50
1799	1	0·47
1808	1	0·38
	2	0·33
1809	1	0·40
1816	1	0·30
1878	1	0·27
1893	1	1·12
	2	0·94
Average -	—	0·66

District No. 6—*continued.*

Chemical Manure Works.

There are 36 works registered for the manufacture of chemical manure, and during the year improvements have been made at the condensing plant belonging to several of the works in this district. The wash-tower at No. 1822 has been increased by the addition of 432 cubic feet. This is not yet sufficient, and further efforts will have to be made at still better condensation. The flue at No. 1861 has been rebuilt and enlarged, while No. 1898 has rebuilt the den and erected a new wash-tower. The condensation at No. 1966 was not as satisfactory as it ought to have been, and at our suggestion a new wash-tower, 16 feet high, has been erected.

The acid gases which arise from the action of sulphuric acid on ground mineral phosphates contain fluorine, and are highly corrosive and offensive. The following Table shows the amount of acid vapour escaping after the washing of these gases. The amount is on the average slightly under that which is equivalent to 0·3 grain sulphuric anhydride per cubic foot of the exit air :—

Register Number of Work.	Total Acidity of Gases leaving Mixer and Den as SO_3 per Cubic Foot.	Total Acidity of Gases after washing Apparatus before entering Chimney as SO_3 per Cubic Foot.	Amount of Acid condensed compared with that produced.
No.	Grains.	Grains.	Per cent.
1770	2·52	0·20	92·07
1783	6·75	0·18	97·34
1797	2·00	0·20	90·00
1813	5·00	0·25	95·00
1821	5·00	0·35	93·00
1822	13·04	1·06	92·64
1823	9·20	0·35	96·20
1831	14·00	0·40	97·15
1842	20·20	0·25	98·76
1845	6·00	0·45	92·50
1846	8·20	nil	100·00
1847	3·55	0·30	91·55
1852	2·50	0·20	92·00
1861	6·20	0·50	91·94
1878	1·60	nil	100·00
1891	8·40	0·45	94·41
1897	1·75	0·25	95·72
1898	1·60	nil	100·00
1912	1·30	0·20	84·62
Average	6·25	0·29	95·36

Nitric Acid Works.

There are three works registered for the manufacture of nitric acid, and the average recorded escape of total acids from the nitric acid condensers = 0·25 grains total acidity as SO_3 per cubic foot.

Ammonium Chloride and Sulphate Works.

There are 70 works registered where the manufacture of muriate and sulphate of ammonia is carried on. The works generally have been found in good repair, and, with one or two exceptions, the purifying arrangements have been found satisfactory.

The following are among some of the most notable improvements :—In three cases (Nos. 1788, 1827, and 1836) continuous stills have been erected, replacing intermittent apparatus. The stills, condensers, and saturators

District No. 6—*continued.*

at Nos. 1800, 1806, 1862, and 1904 have been renewed and improved, while an additional continuous still has been added to Work No. 1855. The sulphate of ammonia plant at No. 1872 has been renewed, and the sulphuretted hydrogen generated at Work No. 1800 is now absorbed in oxide of iron when previously it was burnt in a special furnace. A Claus sulphur kiln and chambers have been erected at Work No. 1827 in place of oxide purifiers. Some difficulty was occasioned soon after starting the process, but it is now working satisfactorily. Two works now use this plan of dealing with the noxious gas.

One new work has been registered during the year, and the sulphuretted hydrogen is absorbed in an oxide of iron purifier.

The total quantity of ammoniacal compounds produced during the year amounts to 7,280 tons.

Cement Works.

The manufacture of cement is carried on at 11 works in this district, and there has been no material alteration in this class of works during the year.

Mr. Edmund Ashby's method for burning the smoke is still in use at his Southampton works. The kilns are charged lightly, and the material is added gradually and more frequently than is usually done. Thus an opportunity is given for more completely burning the smoke and fœtid vapour, the prolonged smoky condition of the kiln is avoided, and the offensive smell which arises from the use of Southampton clay is prevented.

Venetian Red Works.

Copperas is roasted at four works for the manufacture of Venetian Red, either in open kilns or closed furnaces. In order to arrest the noxious gases one work has erected a tower which has been packed with scrap iron; another is passing the acid vapours through a tower, 25 ft. in height, packed with broken saggers, and down which milk of lime and water flows; while a third is utilising the fumes by passing them into an O.V. chamber, where they are converted into sulphuric acid.

It was hoped that the introduction of air and steam into the scrap-iron tower would arrest the sulphurous acid and produce sulphate of iron. This method has not been as successful as was at first anticipated. The sulphate of iron solution so far obtained is very weak, and the liquor has not been evaporated to the crystallizing point.

The amount of acid vapours escaping varies considerably during the process, and the length of time needed to complete the operation depends on the shade of colour which is required.

The following Table shows the amount of acid vapours escaping from the condensers at Venetian Red works. The figures are the average of tests made throughout the year:—

Register Number of Work.	Total Acidity of Gases as SO_3 per Cubic Foot.
No.	Grains.
1874	2·26
1926	1·76
1936	4·47*
Average - -	2·83

* Maximum, 8·80; minimum, 2·25.

District No. 6—*continued.*

Lead Deposit Works.

There is only one work registered in this district where the process of smelting the sulphate of lead, found as a deposit in the sulphuric acid chambers of alkali and other works, is carried on. The sulphuric and sulphurous acids which are thrown off in this operation are caused to pass up a condenser before reaching the chimney, and the acidity is brought under that which is equivalent to 0·35 grain sulphuric anhydride per cubic foot of the exit air. The offensive smell which accompanies the operation of smelting the sulphate of lead is also arrested.

Arsenic Works.

There are 36 works registered in this district for the preparation of arsenious acid, and more than 5,000 tons have been produced during the year.

These works are all situated in Cornwall and the western portion of Devonshire. The arsenic is obtained by roasting arsenical pyrites or as a bye-product in the roasting of tin and copper ores. The arsenic as it is driven off from the roasting furnace is caught, as far as possible, in settling chambers and long flues. Some of these flues and chambers are of great extent. In one case the total length is 3,195 feet, or nearly three-quarters of a mile, and its capacity is 63,795 cubic feet.

The amount of arsenic escaping depends not only on the temperature of the settling flues and chambers, but also on the condition of the roasting furnace and the chimney draught. If the temperature of the exit of the flue does not exceed 70° Fahrenheit, the escape of arsenious acid is usually under one-tenth of a grain per cubic foot. A large number of tests have been taken, and the thermometer readings were in each case carefully registered. The figures have been tabulated, and the average results are given in the following Table. These figures show that as the temperature of the flue is raised, the escape of arsenious acid is increased. If each test could have been made under the same conditions as regards chimney draught and condition of the furnace the figures would doubtless have shown some regular increase. This could not be done, and in some cases, unfortunately, the figure is the average of only a few tests:—

Temperature of Gases at the Flue Exit, given in Degrees Fahrenheit.	Arsenious Acid per Cubic Foot escaping.
	Grains.
Below 60°	0·051
61° to 70°	0·065
71° to 80°	0·112
81° to 90°	0·333
91° to 100°	0·355
101° to 110°	0·294
111° to 120°	0·455
121° to 130°	0·420
131° to 140°	0·411
141° to 150°	0·436

District No. 6—*continued.*

The following series of Tables show the amount of arsenious acid escaping at the end of the long flue or after the final condenser:—

ARSENIC WORKS.—ESCAPES FROM REFINERY FURNACES.

Register Number of Work.	Number of Furnaces in Operation.	Arsenious Acid per Cubic Foot Escaping.	Total Acidity of Gases given as SO_3 per Cubic Foot.
No.	No.	Grains.	Grains.
1924	2	0·051	0·91
1928	3	0·088	1·22
1933	2	0·074	2·20
1942	2	0·082	1·27
1946	14	0·147	1·70
1948	2	0·036	1·50
1955	1	0·068	3·95
1956	2	0·048	1·10
1957	2	0·088	0·65
Average - -	—	0·076	1·61

ARSENIC WORKS.—ESCAPES FROM MECHANICAL CALCINERS.

Register Number of Work.	Number of Calciners in Operation.	Arsenious Acid per Cubic Foot Escaping.	Total Acidity of Gases given as SO_3 per Cubic Foot.
No.	No.	Grains.	Grains.
1931	4	0·051	1·18
1933	1	0·060	2·25
1938	1	0·025	0·46
1939	1	0·069	3·97
1940	2	0·138	2·00
1945	1	0·031	1·10
1946	3	0·122	4·50
1947	1	0·025	1·50
1950	1	0·039	2·56
1952	6	0·237	3·70
1955	1	0·068	3·95
1957	2	0·088	0·65
1959	3	0·339	7·18
1971	3	0·026	0·75
1972	1	0·010	0·54
Average - -	—	0·088	2·42

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District No. 6—*continued.*

Arsenic Works.—Escapes from Roasting Furnaces (Ovens).

Register Number of Work.	Number of Furnaces in Operation.	Arsenious Acid per Cubic Foot Escaping.	Total Acidity of Gases given as SO_3 per Cubic Foot.
No.	No.	Grains.	Grains.
1923	1	0·040	3·80
1924 (1)	1	0·020	1·00
1924 (2)	1	0·113	1·10
1924 (3)	1	0·044	1·50
1940	2	0·042	1·30
1943	1	0·044	1·50
1944	1	0·125	1·98
1952	3	0·035	0·85
1953	1	0·042	1·48
1954	2	0·039	2·43
1956	8	0·048	1·10
1958	1	0·048	6·00
1960	1	0·010	0·58
1961	1	0·076	2·41
1963	2	0·026	0·68
1964	9	0·053	0·55
1965	1	0·010	1·80
1967	2	0·060	0·59
1973	1	0·023	1·23
Average - -	—	0·047	1·68

Arsenic Works.—Kilns.

Register Number of Work.	Arsenious Acid per Cubic Foot Escaping.	Total Acidity of Gases given as SO_3 per Cubic Foot.
No.	Grains.	Grains.
1954	0·039	2·43

Arsenic Works.—White Arsenic Glass.

Register Number of Work.	Arsenious Acid per Cubic Foot Escaping.	Total Acidity of Gases given as SO_3 per Cubic Foot.
No.	Grains.	Grains.
1928	0·068	0·25

Although water does not easily take hold of the finely divided particles of arsenious acid, still some works have erected wash-towers, but care is now being taken not to permit any of the water impregnated with the arsenious acid to flow into the streams.

District No. 6—*continued.*

The following Table shows the amount of arsenious acid and acidity removed from the smoke in this form of condenser :—

Register Number of Work.	Arsenious Acid before Washing Apparatus per Cubic Foot.	Arsenious Acid after Washing Apparatus per Cubic Foot.	Amount of Arsenious Acid removed.	Total Acidity of Gases before Washing Apparatus as SO_3 per Cubic Foot.	Total Acidity of Gases after Washing Apparatus as SO_3 per Cubic Foot.	Amount of Acid Condensed compared with that Produced.
No.	Grains.	Grains.	Per cent.	Grains.	Grains.	Per cent.
1944 1	0·160	0·061	62·21	2·35	0·90	61·70
1944 2	0·040	0·020	50·00	4·00	1·00	75·00
1969	0·275	0·069	74·91	4·40	3·97	9·77
1944	0·260	0·08	69·46	1·50	0·70	53·34
1946 1	0·388	0·147	62·10	2·23	1·70	23·77
1946 2	0·194	0·122	36·76	5·00	4·50	10·00
1954	0·164	0·039	76·22	5·84	2·43	58·39
1955	0·068	0·035	60·00	4·50	3·00	15·56
1973	0·050	0·036	28·00	1·53	1·23	19·61
Average	0·180	0·067	62·46	3·48	2·16	37·94

Dry filters or condensers have been erected at several works. The materials used are thorn, brushwood, gorse, &c. If the chamber is carefully packed and the material is fresh, the condenser is quite successful in arresting the arsenic, bringing it below one-tenth of a grain per cubic foot of the chimney smoke on the average.

The following table gives the results of tests made at condensers filled with brush-wood, gorse, or other dry materials :—

Register Number of Work.	Arsenious Acid per Cubic Foot before the Condenser.	Arsenious Acid per Cubic Foot after the Condenser.	Amount of Arsenious Acid removed.
No.	Grains.	Grains.	Per cent.
1928 1	0·144	0·088	39·10
1928 2	0·035	0·015	57·14
1940 1	0·455	0·155	65·94
1940 2	0·436	0·120	72·46
1940 3	0·088	0·042	52·28
1948	0·149	0·036	75·91
1978	0·103	0·050	51·46
Average	0·201	0·072	64·17

At some of the calcining plants it is found that the acid gases which accompany the arsenic destroy the brushwood too quickly, and some

District No. 6—*continued.*

more desirable material is now sought for. At the works belonging to Messrs. The Tincroft Mine adventurers, a series of experiments were most carefully conducted in order to note the durability of various materials. The following table gives the results of these experiments :—

Nature of Material suspended in the Flue.	Number of Days the Material lasted without Disintegration.
Green willow	7
Dry willow	9
Cocoa-nut fibre soaked in paraffin	10
White hemp yarn	10
White hemp rope	10
Asbestos cloth	12
Cocoa-nut fibre	14
Cocoa-nut fibre soaked in solution of sulphate of iron.	14
Asbestos millboard	15
Blanketing	24
Steel wire	128 and still in good condition when removed.

A dry filter made of short lengths of steel wire is to be constructed at this plant, and we shall note the result with considerable interest.

For certain kinds of ore, calcining in kilns is occasionally adopted. If the ore used contains about 20 per cent. of pyrites, then there is no expenditure in fuel except when the kilns are first lighted. The kilns are simple in construction, being about 3 feet in diameter and 10 feet in height. An iron plate covers the top and this is removed when the ore is introduced. It is stated that in such a kiln 1 ton to 1½ tons is calcined per day, the work being continuously kept up.

White arsenic glass, being arsenious acid in an amorphous vitreous form, as manufactured at two works (Nos. 1942 and 1955). The plant consists of a cast-iron pan, surmounted by a bell of the same material. The latter is removable, the pan, however, is permanently fixed over the fire. When the pan has been heated to a cherry-red heat, a charge of refined arsenious acid is introduced at a hole in the top of the bell, after which the hole is stopped with a plug. The arsenious acid sublimes and on account of the heat and the pressure is deposited on the sides of the bell as a transparent glass. This operation takes about two hours; charge after charge is then admitted until the *arsenic glass* found inside the bell is about 1 inch thick.

The flues at Work No. 1961 were in a dangerous and leaky condition. Repeated warnings were given, and I am now glad to be able to report that a new set of settling chambers and flues have been erected. Work No. 1933 has increased the capacity of the settling chambers by the addition of 384 cubic feet, and work No. 1952 has added 300 feet to the flue, with a capacity of 3,000 cubic feet. Notice boards warning the public of the great danger of walking on the tops of the flues have been set up at two works (Nos. 1945 and 1964).

The number of complaints received during the year have not been so numerous as in the preceding 12 months. The bursting of a "kettle," used in the manufacture of white arsenic glass at Work No. 1928, gave considerable anxiety; but fortunately no one was injured through the accident. Some ore, rich in sulphur, was calcined in May at Work No. 1944. For a short time considerable damage was done to crops and vegetation in the immediate neighbourhood of the works by the escape of sulphurous acid. At my request all operations were suspended, and a wash-tower was at once erected. This reduced the extreme acidity and no further complaints have been received. Several cattle were said to

District No. 6—*continued.*

have been poisoned by arsenic fumes from Work No. 1973. The owners paid compensation to the farmer, although no analysis had been made of the dead animals, in order to ascertain if they had actually died from arsenic. Complaints were made against Work No. 1955, for damage to crops. On careful investigation it appeared, however, that the damage was done by the east wind and not by fumes emanating from the works. We have had to complain of leaky flues at several works; in each case, however, the manager at once had them repaired.

Tar Works.

The distillation of tar is carried on at 10 works in this district, and the methods of dealing with the uncondensed gases from the tar stills, the temperature at which the pitch enters the bays and other details, differ greatly at the various works. The free gases which escape from the condensers of the tar stills contain sulphuretted hydrogen, particularly at the beginning and end of the operation, and some light hydro-carbon vapours. In three cases these gases are led away and consumed in a fire, care being taken to have a water seal introduced between the worm-end and the furnace to prevent firing back, or the last few lengths of the pipe as it approaches the fire is reduced in size. At several other works the gases have been led to beds of oxide of iron, in which the sulphuretted hydrogen is decomposed.

When the pitch is allowed to flow direct into the pitch bay, or open shallow tank, acrid and irritating fumes arise, and these are often carried some distance, causing considerable nuisance in the neighbourhood of the works. I am glad to be able to report that at each work a closed vessel is provided, in which the pitch is allowed to cool to a certain extent before flowing out into the pitch bay. At Work No. 1927 the air, charged with pitch vapours from the coolers, is led away and condensed. The owner is well satisfied with the experiments he has so far conducted.

Methods employed at Tar Works for dealing with Noxious Vapours.

Register Number of Work.	Number of stills used.	Capacity of Stills.	Type of Pitch Cooler used.	Means used for destroying Still Gases.	Remarks.
No. 1775	No. 4	23	Brick -	Oxide of iron -	—
1785	3	25	„ -	„ -	—
1798	2	20	Iron -	„ -	—
1889	5	9	„ (two) -	„ -	The oxide purifier is 20′ × 3′ 3″.
1927	3	10	„ „ -	Burnt -	The vapours from pitch cooler are well condensed at this work.
1932	2	9	Brick -	Oxide of iron -	—
1934	5	25	„ -	Burnt -	—
1935	1	15	„ -	„ -	—
1968	2	15	Iron -	—	This work has been idle for some time, but they intend to have an oxide of iron purifier for absorbing the still gases before restarting the plant.
1970	2	10	„ -	—	This small work is a considerable distance from any dwelling-house, and at present the still gases are washed with a copious supply of water.

District No. 6—*continued.*

Zinc Works.

There are seven works registered in this district where zinc is extracted from the ore. The ores which are usually treated are calamine, the carbonate of zinc, and blend, the sulphide of zinc.

When the sulphide is roasted, sulphurous acid is driven off. "This operation," writes the chief inspector in his Annual Report on "Alkali, &c. Works" for 1893, "like the many other metallurgic processes "whereby sulphurous acid is evolved, must be passed by for the present, "as no effectual means of arresting sulphurous acid from furnaces is "known." Efforts are therefore being made to arrest the white cloud of oxide of zinc which escapes from the retort nozzles during the smelting process. The problem is a difficult one to solve, inasmuch as the white vapour escapes from so many small sources. The determined effort which Messrs. Lysaght, near Bristol, have made with a specially constructed furnace, were mentioned in last year's report. The retorts are heated by gas, and the arrangement is such that all the nozzle ends are enclosed in loose iron plates. The fumes are led away into overhead ventilating shafts and flues of considerable length communicating with the chimney. Large quantities of solid matter are deposited in the flues, and the furnace house is relieved of a considerable amount of fume. The effort has been attended with so much success that a second furnace has been constructed on the same principle.

Alfred C. Fryer.

15th January 1895.

District No. 7.—South-Eastern Counties.

F. Napier Sutton, Esq., F.I.C., *Inspector.*

The number of registered works under inspection in this district during the past year was 210, and shows no alteration from the number registered in 1893. They are classified as follows:—

11 alkali works.
25 sulphuric acid works.
27 chemical manure works.
9 nitric acid works.
73 sulphate of ammonia works.
54 cement works.
1 bi-sulphide of carbon work.
3 Venetian red works.
7 tar works.

The separate manufacturing processes under supervision in the works amounted to 279, as tabulated below:—

3 alkali.
8 hydrochloric acid (cylinder).
28 sulphuric acid.
45 chemical manure.
21 nitric acid.
83 sulphate of ammonia.
2 gas liquor.
2 chlorine.
7 sulphur recovery.
3 antimony sulphide.
2 bi-sulphide of carbon.
3 Venetian red.
1 arsenic.
17 tar distillation.
54 cement.

District No. 7—*continued.*

Three works have been removed from the register as no longer carrying on operations requiring inspection, or on having been closed. These comprised two chemical manure works and one nitric acid work. As against these, three new works have been admitted to the register, namely, two sulphate of ammonia works and one Venetian red work.

I have again had the assistance of Mr. Eustace M. Fletcher in supervising the works in the three southern counties of the district. Certain works in these counties have been periodically visited by me, but most of my time has been devoted to the larger and more important portion of the district north of the Thames.

The total number of visits made to works in the district during the year was 962, of which 334 were made by Mr. E. M. Fletcher, and 628 by myself; the total number of analytical tests made of gases escaping from chimneys and flues amounted to 682, of which number 259 were made by my colleague.

The year's work has been heavy owing to the large number of works, and their distribution over a wide area, making it necessary that much time should be spent in travelling. Such work as was added last year by the Amended Act of 1892 has become more familiar, and most of the difficulties presented by unfamiliar manufacturing operations are now well understood and under control.

It has not been possible to give as much attention as was desirable to certain works, but endeavour has been made to visit all classes of works as frequently as possible. The average number of visits made to the 210 works was 4·5, but special attention has been given to the more important works from which the escape of acid gases is limited by the Act, and to these an average of 12 visits was made, or one visit per month. The greatest number of visits made to any one work during the year was 20, no less than five being made in one month.

It has unfortunately been found necessary to prosecute the Richmond Gas Company, Surrey, for an offence against the Act; a penalty of 10*l.* was inflicted. Explanation of the circumstances leading to this result will be found on p. 99. Quite recently a similiar offence was committed at another work, and a prosecution in this case is now pending.

Alkali Works.

At three works salt is decomposed in pots with roasting furnaces attached, and the acid evolved condensed in stone tanks and ewers. Although the process is carried no further towards the manufacture of alkali proper (the production of acid being the chief object in view), the works are here classed under this definition, in distinction from the cylinder hydrochloric acid works.

The conduct and maintenance of the plant employed at the two larger works (Nos. 2256 and 2248) has been satisfactory, and there are no material alterations or renewals either of the decomposing or condensing plant to report. Plus-pressure furnaces are in use at Work No. 2256, and here no excess of HCl in the chimney test has ever been observed, but the average total acidity of the chimney gases is very high. The chimney in question is the main shaft of the works, and into it are draughted the ex t gases from five sets of sulphuric acid chambers, and the gases from the sulphuric acid concentrating pans. Occasional leaks from these into the hot flues contributes to the acidity of the chimney gases, which on one occasion were found to be equal to 2·0 grains SO_3 per cubic foot.

One excessive HCl chimney test was observed at Work No. 2248. The escape was of brief duration only, and was due to a temporary defect in the water supply to the condensers.

The conduct of Work No. 2105 has been much more satisfactory during the past year than in the year previous, when much trouble was experienced. The average escape for the year is still high, viz., 0·159 grain HCl per cubic foot, but the maximum limit has only been once exceeded, although on two other occasions it has been approached very

District No. 7—*continued.*

closely. The high test mentioned was caused by a leak of gas from the furnace arch into the top flue at the point where the acid uptake pipe passed through the arch. The furnace was stopped at once, and subsequently entirely rebuilt, and the uptake acid flue was then placed at the side of the furnace. The new furnace has proved perfectly sound, and no difficulty of any sort has since occurred. The percentage condensation at this work is very satisfactory, and it would be possible for the chimney escape to reach 0·474 grain HCl per cubic foot without exceeding the 5 per cent. escape limit.

The average chimney escape for the year from the three alkali works is 0·115 grain HCl per cubic foot, and shows very little alteration from that for the year previous. The average escape of acid compared with that produced in the furnaces by decomposition of salt shows a considerable reduction in the figures for both 1892 and 1893, when the escapes were 2·38 and 2·29 per cent. respectively; this has been chiefly brought about by the improved percentage escape from Work No. 2256.

Table showing the Average Tests of Chimneys connected with the Salt-Cake Process.

Register Number of Work.	Per-centage Escape of HCl.	Grains of HCl per Cubic Foot in Chimney Gases.				Average Total Acidity of Chimney Gases, calculated as Grains of SO_3 per Cubic Foot.	
		Maximum.	Minimum.	Average for 1894.	Average for 1893.	1894.	1893.
2256	1·839	0·11	0·06	0·080	0·080	1·10	0·89
2248	1·144	0·27	0·06	0·107	0·110	0·44	0·45
2105	1·676	0·39	0·07	0·159	0·150	0·48	0·51
	1·553	Averages -		0·115	0·111	0·67	0·61

Hydrochloric Acid (Cylinder) Works.

Hydrochloric acid is produced at eight works by the decomposition of salt, in small quantities, in cylinders or leaden stills. The production at three of the works is fairly large for this type of work, but at most of the others the work scarcely exceeds the scale of a laboratory operation. Absorption of acid is in all cases complete, and I have always been satisfied with the condition of the apparatus, and with the care exercised.

The total amount of salt decomposed in the district by all classes of works amounted during the year to 6,295 tons, showing an increase of 393 tons on the quantity decomposed in 1893.

Sulphuric Acid Works.

The number of works producing sulphuric acid in this district shows no alteration from that of last year. The 28 works have altogether 57 sets of chambers, and these have all been in operation; some have continued so during the whole 12 months, whilst others have only been at work for short periods. Three hundred and thirty-five visits have been made to these works during the year, and 450 tests made of the exit gases escaping from the 45 exit trunks connected with the chambers, so that an average of 10 tests has been made from each exit.

District No. 7—*continued.*

Unfortunately I have to report that the Act limit of 4 grains has been exceeded at a somewhat larger number of works. Fifteen of the 28 works have thus offended, with a total of 26 infractions, or a percentage of infractions equal to 5·77 per cent. of the total number of tests taken. This is a large increase both in the number of works offending, and on the number of excessive escapes noticed in 1893, when eight works exceeded the limit with a total of 16 high tests. Although this appears to show a retrograde condition of affairs, I am not sure this is so in reality. Several of the high escapes were due to restarting plant, and only in one instance was the disorganisation of the chamber process observed to last longer than a few hours. Several tests only just exceeded the limit prescribed by the Act, and within an hour or two they were reduced to normal figures. It will be noticed that the average escape for the year shows a distinct improvement on that for the year previous, which is an indication of significance. The greatest number of high tests recorded occurred in March and April, when the heat was quite exceptional for the time of the year, and the chamber space was being taxed to the utmost limit on account of the great demand for chemical manure and the scarcity of acid.

The average escape of acid from the sulphuric acid chambers for the past year was 1·19 grain (calculated as sulphuric anhydride) per cubic foot of exit gases. In 1893 the average escape was 1·25 grains SO_3 per cubic foot.

The care and attention given to the chamber process has in general been satisfactory. In one or two cases the attention given is not sufficiently intelligent, frequent, or regular. Daily, or occasionally even more frequent testing of the chamber exit should be done, and where this is carried out greater regularity in working is always observable.

Work No. 2172 was mentioned in the last Report as having the least satisfactory record. Very little work has been done here during the year, but complaint had again to be made to the firm of want of proper supervision.

Work No. 2173 belongs to the same firm, and here also the supervision of the acid-making process has not hitherto been satisfactory. A promise has now been given that a regular system of testing will be adopted at both works, and this will doubtless have a beneficial result.

Some anxiety has been caused by the constant fluctuation of the chamber process at Work No. 2198. Three sets of chambers are in use, and these are much pressed, the chamber space used being in one case under 16 feet, and in the others not exceeding 17 feet per lb. of sulphur burnt per 24 hours. In this fact probably rests the explanation.

Improvements have been made to portions of the acid plant at Work No. 2200. Another set of burners and the Glover tower belonging to this have been entirely rebuilt, and the absorbing column repacked. This has greatly assisted in reducing the low level escapes of which I have had to complain. Two old sets of kilns which give rise to nuisance in this respect remain as hitherto, but early attention to these is promised. The working of the chambers here has not been very satisfactory at times, but the average escapes show some improvement.

The two sets of chambers connected with the spent oxide burners at Work No. 2205 gave trouble on two occasions. The disorganisation of the chamber process on the last occasion was very persistent, and the cause was traced to the use of oxide containing a high percentage of cyanides. The trouble was lengthened by the carelessness of the man in charge, who failed to supply the chambers with sufficient steam, and paid more attention to the colour of the chamber gases than to the strength of the chamber drips. Here one set of very old chambers (two of which had been in use for over 30 years) has been removed, and is now being replaced by a set of new chambers of much greater capacity.

District No. 7—*continued.*

The acid plant at Work No. 2291, which had recently undergone considerable repairs, was almost entirely destroyed by fire in July. No commencement has yet been made to rebuild the works.

Considerable credit is again deserved by those responsible for the working of the extensive acid plant at Work No. 2146. Only three of the six sets of chambers have been at work continuously throughout the year, but each of the other sets were at work during the earlier months of the year. Only 43 tests have been made of the exit gases against 52 made in the year before. The record has been exceedingly good, and only one brief disorganisation occurred. This was due to a sudden increase in the quantity of sulphuretted hydrogen passing to one set of oxide burners. The supply of oxides of nitrogen in the chambers was adequate, but these existed as N_2O_3 owing to the absence of sufficient air. This was quickly rectified, and within two hours the exit gases had an acidity of only 0·3 grain SO_3 per cubic foot. Some of the older plant here had fallen into bad repair, but this is now having attention, and extensive renewals are being made.

Another most excellent year's record has been again shown at Work No. 2152. An average of the 12 tests taken during the year shows an escape of only 0·5 grain per cubic foot, with a maximum test of 1·0 grain. Considering the trouble experienced here some four years ago, this shows that very considerable care is now constantly exercised, and the results merit great praise.

Additional sulphuric acid plant has been erected during the year at two works. In each case the acid producing capacity of the works has been more than doubled. The new plant at Work No. 2202 consists of three chambers with coke column and 12 pyrites kilns, and at Work No. 2242 of three large chambers with Glover and Gay-Lussac towers, and 26 pyrites kilns. Neither of these plants will be ready for work until the new year.

A fatal accident occurred in the month of August at one of the works in London during the repacking of a Gay-Lussac tower. The tower had been blocked off by a stop damper from the rest of the plant, and had been ventilated, washed down, and unpacked. During the early stages of repacking (with new earthenware cylinders) two labourers were overcome by nitrous fumes, and one died the next day. The presence of gas could not be explained, but evidence pointed to evolution of oxides of nitrogen from the old brick lining of the tower. An accident under similar circumstances is exceedingly rare, if not unique, and it is evident that the usual washing down and ordinary method of upward ventilation cannot be relied upon with absolute safety. The only safe and rational method of ventilation of towers during unpacking or repacking is downward ventilation, which can readily be obtained by using a steam exhaust in the inlet gas-pipe at the base of the tower, the current being reversed and outwards.

The maintenance of acid plant generally has been satisfactory, but in two instances it was necessary to urge stoppage of plant for much needed repairs. The usual necessary annual repairs required to maintain plant in fair working order have in most cases been carried out, but such need no special comment.

The condensation of acid fumes driven off during the concentration of acid to O.V. has in all cases been effectively carried out, as will be seen on referring to the table of tests. A Webb's patent continuous plant, in which a series of porcelain beakers are used, has been erected at one work, and has been working for some months. During its earlier career escapes of acid fumes, both from breakage and sweating, gave rise to some trouble, but latterly no difficulty has occurred, and the substitution of a new beaker after breakage is now quickly and neatly accomplished without any escape of fumes. The acidity of the chimney gases connected with the plant is low, although the smoke at times looks suspiciously white.

District No. 7—*continued.*

TABLE showing the AVERAGE TOTAL ACIDITY in the EXIT GASES from SULPHURIC ACID CHAMBERS.

Register Number of Work	No. of Exit.	Total Acidity in One Cubic Foot of Exit Gases. Grains of SO_3.	Source of Sulphur.	Remarks.	Average Escape for previous year, 1893.
2291	—	0·97	Pyrites smalls	The entire acid plant was destroyed by fire in August. First half-year's record of work very satisfactory.	1·40
2199	1	1·05	Pyrites	This set has undergone substantial repair.	1·70
	2	1·86	Pyrites smalls	The average escape is unaccountably high. Under excellent management.	1·86
2108	1	1·35	Brimstone	The work here is carefully conducted.	1·31
	2	1·05	„		1·44
2121	—	1·01	Pyrites	A very satisfactory year's record	1·01
2146	1	0·43	Pyrites, Spent Oxide, and Sulphuretted Hydrogen	Great care has been taken and most excellent results again obtained. Only one slight disorganisation was observable during the year, and was of very brief duration.	0·72
	2	0·87			0·73
	3	0·55			0·56
	4	0·63			0·69
	5	1·43			1·14
	6	0·91			1·11
2248	1	0·82	Pyrites		1·08
	2	1·06	„		0·88
2129	—	1·39		The year's work has been very satisfactory.	1·44
2136	—	1·63	Brimstone	One chamber only, working about five months in the year.	1·41
2356	1	1·10	Pyrites	Includes exit gases from three sets of chambers.	0·97
	2	1·50	„	Includes exit gases from two sets of chambers.	1·67
2202	—	1·96	„	Chamber space too much pressed. An additional set of chambers has now been erected.	2·18
2167	—	1·50	„	The average escape is higher than it should or used to be.	1·45
2151	—	0·71	„	Year's work most satisfactory. Great improvement shown.	1·25
2152	—	0·50	„	An admirable year's record. Maximum of 12 tests equal 1·05 grains.	0·73
2155	—	0·59	„	One brief outburst occurred, record otherwise very good.	0·62
2161	1	1·10	„	No. 1 set has given trouble on three occasions; outbursts slight, and of brief duration. No. 4 set was idle during 1893; working four months during 1894.	1·25
	2	0·94	„		1·35
	4	1·25	Brimstone		—
2156	—	1·63	Pyrites	Two chambers only. Record not so satisfactory as in 1893.	1·10
2172	—	1·74	Pyrites, Oxide and H_2S.	Very little work has been done here this year.	2·81
2173	—	1·66	Brimstone	Greater care and more constant supervision is required.	
2179	—	1·08	Spent Oxide and Brimstone.	Occasional trouble has occurred notwithstanding careful management.	0·95
2190	—	0·58	Pyrites	Includes exit gases from four sets of chambers. Record entirely satisfactory.	0·71
2198	1	1·01	„	Some anxiety caused here by constant fluctuation of chamber process. No. 3 exit average of 15 tests spoilt by two high tests. Average of 13 tests gives only 0·66 grain.	0·96
	2	1·45	„		1·14
	3	1·83	„		0·87

District No. 7—*continued*.

Register Number of Work.	No. of Exit.	Total Acidity in One Cubic Foot of Exit Gases. Grains of SO_3.	Source of Sulphur.	Remarks.	Average Escape for previous year, 1893.
2200	1	1·04	Pyrites	Improvement in some respects has been shown. The local escape of gas from some of the old burners is a standing source of complaint and nuisance.	1·78
	2	1·55	„		1·21
	3	1·37	„		1·18
	4	0·92	„		1·79
2205	1	0·84	„	No. 1 set has worked very satisfactorily. The "oxide" set has given some trouble; complaint of carelessness had to be made on once occasion.	0·74
	2	2·21	Spent Oxide and Brimstone.		2·15
2263	—	1·46	Pyrites	-	0·95
2209	—	0·73	„	Seven chambers worked here in one series.	1·03
2231	—	1·20	„	Towers are being added to this plant.	1·85
2155	—	1·30	Pyrites and H_2S	Record not so good as for year previous.	1·21
2242	—	0·99	Pyrites and H_2S	An excellent year's record. An additional set of chambers and towers in course of erection.	1·49
		1·19	Average for 1894.	Average for 1893	1·25

Table showing the Average Escapes from Rectifying Apparatus.

Register Number of Work.	Total Acidity as SO_3 per Cubic Foot.	Remarks. Tests taken after Acid had been boiling at least three hours.
2108	0·35	From 20 glass retorts, waste gases pass through coke scrubber.
2248	0·75	From 50 glass retorts, gases pass through coke scrubber.
„	0·55	Average acidity of chimney gases connected with Webb's continuous O.V. plant.
2161	0·15	From pans and platinum still, test taken at end of very long flue before entering chimney.
2179	1·25	From 30 glass retorts, waste gases pass through coke scrubber.
Average	0·61	Average escape for 1893 = 0·92 grain.

Chemical Manure Works.

Two small chemical manure works have been closed during the past year, so that only 47 works have been in operation as against 49 in 1893. The past season's work was a particularly busy one owing to the great demand for artificial fertilisers produced by the scarcity of farmyard manure. The demand for acid in the London district, particularly during the spring, was very great, and high prices were demanded by the few

District No. 7—*continued.*

firms who had acid for sale. The output of manure for the season was probably quite exceptional, but this activity is scarcely likely to be maintained under the altered circumstances of a disastrous summer and harvest, and the lamentable condition of agriculture generally.

But little change has been made in the apparatus employed at the works for the treatment of the volatile fluorine compounds evolved during the treatment of mineral phosphates with sulphuric acid, but the more important alterations and improvements are quoted in detail below. The condensation of the acid compounds evolved shows very little variation from that of recent years. The average escape for the district is 0·25 grain acidity (calculated as sulphuric anhydride) per cubic foot of gases leaving the condensers, and the amount condensed compared with that evolved in the mixers is 98·58 per cent. This shows a slight improvement in the actual escape at the condenser exits, and a slight decrease in the percentage condensation, which appears to be somewhat paradoxical. In 1893 the figures above quoted were 0·25 grain per cubic foot and 98·63 per cent.

Forty-five tests were obtained from 19 of the larger and more important works, and the average results are given in the table which follows, with remarks showing condition of efficiency and the means employed for obtaining draught on the mixing and condensing apparatus. Experience again shows that the bests results are obtained by treating the gases in as concentrated a condition as possible, and allowing as much time as possible for contact between gases and condensing surfaces compatible with sufficient draught to keep the mixing floor free of gas. To this end properly adjusted steam jets in the flues are preferable to draughting fans, which are almost invariably driven at too great a speed, with loss of condensing power by reason of excessive dilution and want of time contact.

Very little work has this year been done at No. 2172, and here the manufacture of manure is not likely to be resumed. The plant was old and badly designed, and by no means efficient. All the other works may now be said to possess adequate condensing power, and in every case in which tests have been made the condensation obtained exceeds 95 per cent. which is now recognised as the minimum limit. In the majority of cases a condensation of 99 per cent. is obtained.

Among the chief improvements carried out during the past year the following may be mentioned. At Work No. 2202 three additional brick wash towers have been built. The old long underground flue has been replaced by a new flue of larger area but of less length; a steam jet has been inserted in the flue (fan also used), and material condensation is obtained before the gases reach the condenser. The revolving condenser designed and built at Work No. 2161 in 1888 (plans given in 25th Report, p. 98), had become worn out after nearly seven years' useful work, and has been replaced by a new "revolver" of similar design but modified to allow of being more readily cleaned. This apparatus does a very large amount of work with a minimum consumption of water and space. Here a depositing chamber is to be added with a view to relieve the revolver from the large amount of work now thrown upon it. At Work No. 2156 considerable reduction in the escape of acid gases at the mixer has been obtained by altered construction of the mixer casing, and by substituting new and enlarged flues. An additional brick wash tower has also been built, which should assist condensation very greatly; no opportunity for testing has occurred since these improvements were completed. Satisfactory condensation has been maintained at Work No. 2198, where very large quantities of material are treated. The large fan formerly used here has been removed and a powerful jet of exhaust steam has been substituted. This is placed practically at the end of the condensing plant, and a considerable volume of steam escapes from the exit, and has a bad appearance. It would be better to introduce this steam at some point between the mixers and the condensing towers, and it is hoped this alteration will be made. The draught on the mixers appears equally

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good as when the 6 foot fan was in use. At Work No. 2231 the brick dens have been rebuilt and enlarged; in this one instance the gases after treatment in the wash towers pass to the boiler fires, and there any organic smell is destroyed.

A new and very well designed manure plant has been built at Work No. 2242, consisting of duplicate vertical mixers and brick dens; connected with these is a large brick condenser (dry), with circulating flues and a single wash tower of large area, 35 feet in height, packed internally with cross bars. This plant has not yet been in use, but the old mixing plant has been actively employed. The condenser at work No. 2147 has been entirely rebuilt and improvements introduced.

TABLE SHOWING the AVERAGE AMOUNT of ACIDITY ESCAPING from the CONDENSERS in MANURE WORKS.

Register Number of Work.	Total Acidity in 1 Cubic Foot of Gases in terms of SO_3.		Per-centage of Acid Vapour condensed compared with that evolved.	Remarks.	Average Escape from Condenser Exits for 1893.	Average Per-centage Condensation for 1893.
	Den and Mixer Gases.	Condenser Exit.				
2199	24·40	0·60	97·55	Very large mixings made, excellent draught obtained by steam jet only.	0·55	97·81
2123	—	0·20	—	Fan; steam admitted to assist condensation. Satisfactory.	0·15	—
2202	22·50	0·40	98·23	Condenser enlarged, but underground flue leading thereto has been re-constructed and shortened, throwing more work on condenser.	0·30	98·77
2167	17·25	0·15	99·13	Very satisfactory. Steam jets used at two points.	0·20	99·59
2151	18·50	0·30	98·38	Very efficient. Draught by steam jet only.	0·30	97·73
2152	13·30	0·10	99·25	This plant used for compound manures only. Chimney draught.	0·05	98·83
	—	—	—	No test obtainable from mixing of "super." Fan.	0·05	99·45
2161	16·85	0·10	99·40	"Revolver" has been re-constructed, and condensing plant improved. Fan.	0·50	97·98
2156	—	—	—	Condensing plant enlarged and much improved. Not tested since alteration. Steam jet and chimney.	Trace.	99·90
2172	—	—	—	Little or no mixing has been done this season.	0·30	96·37
2190	36·00	0·17	99·51	Condensation assisted by long underground flue. Fan and steam.	0·40	98·57
	4·25	Trace	99·90	Only test obtained was from "compound" mixing. Condensers efficient.	0·40	98·75
2198	31·37	0·30	99·05	Now much more satisfactory than formerly. Steam jet has replaced fan.	0·20	99·46
2200	58·00	0·15	99·74	Satisfactory. Fan used -	0·15	99·12
2209	24·35	0·10	99·59	Very satisfactory. Depositing chamber in use. Steam jet and chimney draught.	0·30	99·41
2231	13·50	0·35	97·41	Fairly efficient. Gases from condensers pass to boiler fires.	0·50	97·40
2263	15·85	0·30	98·74	Generally efficient but two bad tests were obtained. Chimney.	0·25	99·20
2242	18·50	0·15	99·19	Very efficient condensation. Steam jet.	0·15	99·22
2201	7·50	0·15	98·00	Satisfactory. Depositing chamber in use. Steam jet.	0·15	97·93

District No. 7—*continued.*

Register Number of Work.	Total Acidity in 1 Cubic Foot of Gases in terms of SO_3.		Per-centage of Acid Vapour condensed compared with that evolved.	Remarks.	Average Escape from Condenser Exits for 1893.	Average Per-centage Condensation for 1893.
	Den and Mixer Gases.	Condenser Exit.				
2124	5·40	0·20	96·30	The one test obtained unsatisfactory. Usually good. Steam jet.	0·35	98·91
2134	—	—	—	No opportunity to test has occurred. "Compound" only made.	—	—
2147	26·25	0·60	97·72	Condenser has been rebuilt. Satisfactory. Steam jet.	0·45	98·59
2194	15·00	0·30	98·00	Satisfactory. Works isolated. Chimney draught.	—	—
2260	25·75	0·50	98·06	Efficient. Much care necessary, surrounded by houses. Steam jet.	0·40	98·50
Averages		0·25	98·58	Averages for 1893 =	0·27	98·63

NOTE.—The above figures represent the average quantity of acid evolved during the mixing of superphosphates, or the strongest mixing of mineral phosphates made at the works.

SULPHATE OF AMMONIA WORKS.

Eighty-three works have been in operation during the year for the manufacture of sulphate of ammonia, other ammoniacal compounds are produced in a few instances, and these include carbonate and nitrate of ammonia, liquid (refined), and anhydrous ammonia. Of this large number of works only 18 belong to private firms and the balance of 65 works belong to Gas Companies. The proportion of sulphate manufactured by the latter amounts to 72·7 per cent. of the total product.

The total quantity of ammoniacal compounds produced during the year 1894 amounts to 40,344 tons, calculated as sulphate of ammonia. This is an increase of 945 tons on the quantity made in 1893, and it is the largest yield that has yet been produced by this district.

Two new works have been registered during the year. One of these belongs to a large London gas company, and the still employed is of the newest pattern. Provision was at first made for burning the sulphuretted hydrogen evolved, but this method could not be sanctioned and arrangements have now been made whereby the gas is passed by underground pipes to a neighbouring acid works, and it is there successfully utilised for sulphuric acid manufacture. The other work belongs to a small provincial gas company, and here the intermittent system of distillation is used with oxide purification.

The methods adopted in the different works for dealing with the sulphuretted hydrogen evolved during the distillation of gas liquor do not show any great amount of change, but in a few instances methods have been altered. A very large proportion of the sulphuretted hydrogen is utilised for sulphuric acid manufacture, amounting in the past year to 59·4 per cent. of the whole; 14 per cent. is treated by the Claus sulphur recovery process, 9·4 per cent. is absorbed in oxide of iron purifiers, and the remaining 17·2 per cent. is destroyed by combustion in boiler fires, retort flues and special kilns, the resulting sulphurous acid escaping with the chimney gases into the atmosphere.

At the time when the Act of 1881 first brought this class of work under control, the combustion method was temporarily adopted in many cases as a ready and cheap way of getting rid of the noxious gases evolved in the distillation of gas liquor, until better methods had been proved practicable. Such were quickly devised, and came into general use and have since grown in favour. Unfortunately the cheap and easy method

District No. 7—*continued.*

of destroying the H_2S by burning has had great fascination for some managers of works who have been less anxious for the health and comfort of their neighbours than to save a trifling expense in manufacture. The Act, however, requires that "the owner of any work shall use the best "practicable means for preventing the discharge into the atmosphere of "all noxious gases and all offensive gases evolved in such work or for "rendering such gases harmless and inoffensive when discharged, &c." The combustion of H_2S in a fire, retort, flue or kiln (when not used for acid manufacture) necessitates the escape of the resulting sulphurous acid, but other methods are in general use, namely, the Claus sulphur recovery process and oxide purification, whereby complete destruction and absorption of this noxious gas is obtained; it would seem, therefore, that the combustion method cannot possibly be considered as the "best practicable."

There are one or two large and several small offenders as regards the practice of burning H_2S and allowing the products to escape, and cases have recently occurred of reversion to this deleterious practice. A considerable number of tests have been taken from the chimneys connected with the boiler fires or special kilns in which H_2S is burnt, and the products of combustion allowed to escape. The average total acidity of the chimney gases is very high, namely, 2·24 grains (as SO_3) per cubic foot. At one of the works two very high tests were obtained, of 9·5 grains and 6·75 grains SO_3 per cubic foot of chimney gases. Protest was made and since then the acidity has been greatly reduced by enlarging the flues, and thus diluting the chimney gases. At this work, and also at two others, H_2S from the extensive sulphate of ammonia plant is burnt by itself in special kilns, a coal gas jet being used to ensure continuous combustion. The acidity of the kiln gases is in every case very high. The following figures show the average acidity of the kiln gases and also of the chimney gases after dilution has occurred:—

Work.	Kiln gases. Grains of SO_3 per cubic foot.	Chimney gases. Grains of SO_3 per cubic foot.
No. 2287	— (before alteration of flues)	8·12
2287	58·22 (after additional dilution)	2·20
2302	33·75	1·90
2305	54·37	2·40

It is clear from these figures that the acidity of the chimney gases may give a very erroneous idea of the true amount of acid sent into the air, for an average of the figures above quoted show one volume of kiln gases to be diluted in the chimney by 22·5 volumes of air or chimney gases, or a dilution equal to 95·5 per cent. It has been calculated that the quantity of sulphurous acid sent into the atmosphere of London by the combustion of the sulphuretted hydrogen evolved in *one* of the works referred to is equivalent to 3½ tons of commercial OV (80 per cent. H_2SO_4) per week.

The Claus sulphur recovery process has been further extended to two additional works during the year, making a total of eight works at which this process has been adopted. One of these new plants has been at work periodically during the greater part of the year, but the other has only

District No. 7—*continued.*

just been completed and has not yet started work. Altogether nine sulphur kilns and auxiliary depositing chambers are employed. Substantial repairs have been necessary to the brick chambers in two cases, but two others which have also been at work for many years will shortly need attention; with the exception of these two, all are in good working condition. Sixty-nine tests have been made during the year of the waste gases from the sulphur chambers before and after treatment in the limestone towers. The results show that the average acidity of the waste gases leaving the chambers is equal to 10·4 grains SO_3 per cubic foot, and that after neutralisation in the limestone towers this acidity is reduced to 1·7 grains SO_3 per cubic foot, which amount passes on, with any H_2S that may be present, to the catch oxide purifiers and is there finally absorbed. These average figures are a good deal higher than they should be and this is due entirely to the bad results obtained at one work. Eliminating the average tests from this one work the average escapes from the others would be 8·9 grains and 0·63 grains per cubic foot. Excellent results are obtained by the process at two or three of the works, but particularly at Work No. 2138, where the figures at the two points indicated (average of ten tests) are respectively 2·66 grains and 0·05 grains per cubic foot.

Oxide purification is used at 48 of the 83 works for treatment of the sulphuretted hydrogen evolved in the process of sulphate of ammonia manufacture. This method is chiefly in use at the smaller works where the annual production varies from 5 tons up to 150 tons. This is successfully accomplished at one work at which the annual make of sulphate is 250 tons, but most of the works having a larger production than 150 tons use the Claus sulphur recovery process. Oxide purification, however, is about to be tried (with intermittent revivification *in situ*) at a new work where the expected make of sulphate amounts to 30 tons weekly and 700 tons annually. This is the largest scale on which oxide purification has been attempted in this district, and the results will be watched with much interest.

Several attempts are being made to prolong the active condition of the oxide by revivification *in situ*. This is done both by direct and continuous supply of air (admitted into the foul gas main by steam injection), and by intermittent downward draught of air through the purifiers by connexion with chimney draught when the purifiers are out of action. There is no doubt that considerable advantage is obtained by both systems, but sufficient time has not yet elapsed to form a reliable opinion as to which method gives the better results.

An attempt has been made to arrive at the average cost of the treatment of H_2S evolved in the manufacture of sulphate of ammonia, (i) by absorption in oxide of iron purifiers, and (ii) by the Claus sulphur recovery process. For this purpose inquiries were addressed to the managers of some 25 works, at six of which the Claus process is in use, and oxide purification at the remainder. The capacity and type of the plants at these works varies greatly, some of the stills being intermittent and some continuous in action. The condensing and purifying power also differs greatly, and in a few cases attempt is made to revivify the oxide *in situ*. Unfortunately it was found that in the large majority of the works where oxide purification is employed no separate account is kept of the oxide used, and the labour expended on the purifiers attached to the sulphate plant. In a few cases this is done, or the cost could be estimated closely, and the figures were readily and courteously given me. In all cases of oxide purification, interest on capital for condensing plant and purifiers have been charged and account taken of value of oxide used less sulphur recovered and labour expended.

In calculating the cost of the Claus process, interest on capital outlay, maintenance, and labour, less value of recovered sulphur, are included. The cost quoted in each case is that per ton of sulphate made.

District No. 7—*continued.*

ABSORPTION OF SULPHURETTED HYDROGEN BY OXIDE OF IRON.

Register Number of Work.	No.	Method of Distillation.	Cwts. of Sulphate of Ammonia made per 24 Hours.	Tons of Sulphate of Ammonia made per Annum.	Cubic Feet Oxide available per Ton of Sulphate of Ammonia produced per 24 Hours.	Cost of Purification per Ton of Sulphate of Ammonia made.
						s. *d.*
2131	1	Continuous	20	100	384	2 6
2208	*2	„	33	115	260	1 6
2212	3	Intermittent	—	117	—	3 4
2236	*4	Continuous	30	152	324	3 0
2281	5	„	33	162	486	5 5
2288	6	Intermittent	5	45	—	7 1
2299	7	„	7	52	343	3 6
Average cost per ton of sulphate of ammonia made -						3 9

* Means used here for revivification *in situ*.

TREATMENT OF SULPHURETTED HYDROGEN BY CLAUS SULPHUR RECOVERY PROCESS.

Work.	Annual make of Sulphate of Ammonia.	Cost per Ton of Sulphate of Ammonia made.
No.	Tons.	*s.* *d.*
2138	669	0 8
2139	1,866	1 1
2161	630	0 11½
2265	847	1 1
2294	308	1 1½
Average cost per ton of sulphate of ammonia made -		1 0

The wide variation shown in the first group of figures is somewhat surprising, but in the extreme cases some explanation can be given. The highest cost is No. 6. The plant is intermittent in action and the condensing power is much too small. The gases enter the purifier hot and highly charged with moisture, so much so that the oxide becomes very wet and dense, and requires frequent change before being actually fouled. The available purifying space is not known, but it would be ample under favourable conditions; the obvious remedy is increase of condensing power. In the case of No. 5, the condensing and purifying plant has been very expensively erected, and the former is disproportionally large for the work required of it. Taking the interest at 7½ per cent. on the capital charges for these two items, the cost amounts to 1*s.* 2¼*d.* and 10½*d.* respectively, or taken together 2*s.* 0¾*d.* per ton of sulphate. The other items given in this case are 9¼*d.* for oxide and 2*s.* 7*d.* for manipulation of oxide, making up a charge of 5*s.* 5*d.* in all. As to the lowest cost quoted (No. 2), the condensing and purifying plants were

District No. 7—*continued.*

erected at small cost, but they are very efficient. The purifiers are constructed of concrete made of beach shingle (obtained close at hand) and cement, and revivification of the oxide is carried out very successfully by alternately connecting the purifiers when out of action with the chimney draught, and so obtaining a slow downward current of air through the oxide. I have reason to believe that if a larger number of figures could have been obtained, the average cost of oxide purification would have worked out nearer 2*s.* 6*d.* than 3*s.* 9*d.* per ton of sulphate, as shown by the figures actually quoted.

Great uniformity is shown in the cost of the treatment of H_2S by the Claus process, although the quantity of gas treated at the different works varies considerably. In no case does the process show a profit, but the average cost of 1*s.* per ton of sulphate compares very favourably with that of purification by oxide. Satisfaction has been frequently expressed at the working of the process by those who have experience of it. The manager at Work No. 2138 writes, "It is a very efficient means of dealing "with the gas, and I should be sorry to be without it." The manager of Work No. 2137, who has recently adopted the system, writes, "By working "the Claus process we have not found it necessary through its use to add "to the staff in any degree"; and, again, the manager of Work No. 2294 writes, "It has worked satisfactorily all the time, and entirely does away "with the sulphuretted hydrogen nuisance."

It is with very great regret that I have to report the discovery at two separate works of the existence and use of secret bye-pass pipes whereby sulphuretted hydrogen was passed to the retort flues instead of to the existing oxide purifiers ostensibly provided for its treatment. The first of these was found to be in use at the works of the Richmond Gas Company. In this case the offence was aggravated by reason of the statements made on the part of the manager with regard to the use of the purifiers. Legal proceedings were commenced under clause 17 of the Act, but the case was not defended, and the fine (10*l.*) claimed was paid. The other case was detected quite recently at the works of the Mitcham and Wimbledon Gas Company, and a prosecution of the manager is now pending.* In both instances I had been led to believe by the statements of the managers that the whole of the foul gases were passed to and exclusively treated in the existing purifiers. Quite accidental circumstances revealed the existence of the bye-pass pipes, and had not such occurred their use might have remained undetected till the present time. There is no kind of deception more difficult to detect than the existence of concealed pipes, and by their use the inspector is misled as to the method of treatment and as to the position of outlet of the gases into the atmosphere.

Nitric Acid Works.

Nitric acid has been produced at 22 works during the year; one small work, at which two cylinders were in use, has been closed, and the plant dismantled. In every case (with one exception) the manufacture has been carefully and satisfactorily conducted, and all plant has been maintained in a good state of efficiency. The exception to the above consists of a plant of four cylinders with batteries of Woulf's condensers, at Work No. 2353. The dilapidated and dirty condition of this plant is a constant source of anxiety. A somewhat serious escape of acid occurred here from the fracture of a cylinder while the charge was on full boil; the evolution of acid fumes was beyond control for some time, and caused considerable annoyance to the cottage property which closely surrounds the work.

Additions have been made to the plant at four works. The only item of interest is the erection of two additional Prentice continuous nitric acid stills at Work No. 2209. One of these is very large, and decomposes 14 tons of nitrate of soda per week. An excellent condensing battery,

* The penalty of 10*l.* has been paid.

District No. 7—*continued.*

provided with perpendicular condensing pipes between the receivers, is connected therewith. The waste gases from the extensive nitric acid plant in use here are recovered in a small Gay-Lussac column, and utilised in the manufacture of sulphuric acid.

Cement Works.

There is nothing fresh of importance to report with regard to this class of work. The number of works registered in the past year was 54, and shows no change from the year previous. The eight open kilns formerly in use at Work No. 2217 are now being converted into close kilns of the Wilder's pattern, and these will be draughted to a chimney 120 feet in height.

Sulphide of Antimony Works.

Three works are registered for the manufacture of this material, but only two have been in active operation during the year. The plant at work No. 2278 remains precisely as before. The sulphuretted hydrogen generated during precipitation of the sulphide is effectually draughted to an oxide purifier, and no nuisance appears to exist.

The plant at Work No. 2292 has been twice altered. Early in the year provision was made for draughting the sulphuretted hydrogen by a powerful fan, through a main of earthenware pipes to a series of three small oxide purifiers. The large volume of gas to be dealt with, owing to indraught of diluting air through imperfect joints, and the resistance offered to the passage of the gases by the purifiers, prevented this method from being successfully continued. A perfectly tight main flue of wood has now been constructed, to which the precipitating vessels are connected when required by a large flexible pipe. A fan provides the necessary suction, and the gases are passed through the bed of a specially designed furnace or kiln. No opportunity has yet occurred for an examination of the chimney gases connected with this furnace, but there is every reason to believe that the sulphuretted hydrogen is effectually destroyed.

There are two possible sources by which nuisance may arise, the initial evil of H_2S evolved during precipitation, and the effluent liquors and wash waters containing H_2S in solution; but I have heard of no complaint of nuisance arising from either works.

Carbon Di-Sulphide Works.

Carbon di-sulphide manufacture has been carried on at two works in the district. The condensing plant at one of the works has been entirely rearranged and much improved. The waste gases (carbon di-sulphide vapour and sulpuretted hydrogen) here are effectually treated by combustion, and they appear to burn freely and continuously. Portions of the plant have been renewed at the other work, which is situated in a very isolated position. Here the waste gases are dealt with by oxide purification, and this is effected in a purifier containing a large number of shelves with an inch or so of oxide on each. Absorption and saturation are readily obtained, and this form of purifier offers no resistance to the passage of the gas, and therefore produces no back pressure. Pressure or vacuum on the condensers are alike objectionable, and should be avoided; the former creates difficulty and danger when charging the retorts, and any vacuum is dangerous by reason of indraught of air at the retorts, and wasteful by drawing off uncondensed carbon di-sulphide vapour. No complaint of nuisance has arisen in this manufacture.

Venetian Red Works.

A fresh work has been registered during the year, making three now on the register for the manufacture of Venetian red. Furnaces for the

District No. 7—*continued.*

production of this colour have existed at the newly registered work for some years, but these have been idle since the amended Act came into force.

The other two works have been almost continuously active throughout the year. At Work No. 2118, tests have been made periodically of the gases leaving the furnaces, and the acidity has on no occasion exceeded 2 grains, and an average of the tests obtained gives only 1·54 grains as SO_3 per cubic foot. The furnace flue delivers the gases into a large chimney, where further dilution occurs, and here the acidity is reduced to 0·3 grain SO_3 per cubic foot. In spite of this very low acidity, the chimney gases have a very white appearance, the character of which might very easily be mistaken.

The experimental furnace mentioned in the last Report as having been erected at Work No. 2317 has been replaced by a larger permanent furnace, which has been at work during the greater part of the year and gives most excellent results. The acid vapours driven off from the "pockets" containing the copperas slabs are led into a common flue used exclusively for this purpose and are draughted away to the condensers in an undiluted condition. The charges in the different pockets are in various stages of decomposition, being charged in rotation, and thus the acid gases leaving the furnace have at all times a very equal composition; the furnace process is in fact continuous, and there is no great evolution of acid vapours at any one period, and the difficulty of condensation is thereby very greatly lessened. The acid vapours, on leaving the furnace, are led into a brick tower filled with small fireclay cylinders, such as are now generally used for packing the Glover towers in sulphuric acid works. The tower is provided with a copious water spray, and the bulk of the sulphuric acid in the vapours is removed here. The residual gases, which chiefly consist of dilute sulphurous acid and water vapour, are divided between two tall towers containing hard limestone kept moist by a continuous water spray. In these the sulphurous acid is neutralised, and the gases escaping from the top have rarely been found to exceed 1·5 grain (as SO_3) per cubic foot, and in general are much lower. These towers were originally packed with scrap iron, and the sulphurous acid was arrested in part, and recovered as sulphate of iron. Good evidence of the practicability of this system was obtained, but the cost of pumping the liquor again on to the towers to increase the percentage of sulphate in it, and the subsequent concentration and crystalization of the salt, was not found to answer, in view of the present low value of copperas. There can be no doubt that the new type of furnace referred to above is a very great advance upon the older forms still generally in use, and that it entirely fulfils the requirements of the Act.

Arsenic Works.

The one small plant by which arsenic acid is produced remains as before. The condensing plant provided for arresting the oxides of nitrogen is adequate and effective.

Tar Distillation Works.

There is no alteration in the number of works distilling tar, or in the number of stills employed. The 17 works have all been in active operation, and these have a total of 118 stills. The large majority of these are 12 to 14 ton pot stills, the remainder consist of five patent horizontal stills of large capacity, and two patent continuous stills.

Considerable advance has been made in the methods employed for treating the vapours and permanent gases evolved at the still worm end, and in minimising the nuisance produced during the running off of the hot pitch from the stills, especially in those works which during the first year of inspection were most backward in this respect. In almost all

District No. 7—*continued.*

cases the means employed are now better understood, and are more regularly and satisfactorily worked by the men in charge.

I am still of the opinion that the permanent gases are best dealt with by combustion. This method affords a ready, safe, and cheap means of getting rid of all the noxious gases evolved. If these are first drawn through a washer containing heavy tar oils, all light naphthas, as well as other condensable hydro-carbon vapours, are retained and can be recovered, and all permanent gases passing on to the boiler fire are there destroyed, and the heat produced by their combustion utilised. In some of the works, particularly those in which the gases are not washed through heavy oils, the volume of combustible gases seen burning under the boilers is at times astonishing, and the steady heat produced must effect a considerable economy in fuel.

Treatment of these gases by oxide of iron is less satisfactory on account of the resistance offered to the passage of the gas by the mass of oxide, and the consequent lessening of the vacuum which is so necessary to be maintained on the receivers. The other drawbacks to this system are the incomplete absorption of all hydro-carbon vapours, and the impregnation of the oxide by naphthaline crystals, which interfere with absorption, and with the subsequent reoxidation of the oxide. A very strong smell of benzol is always noticeable over and in the vicinity of the oxide purifiers thus employed, and an examination of the oxide has repeatedly shown it to be loaded with naphthaline crystals. There is no doubt that an appreciable amount of very light benzol vapours escape condensation in the ordinary form of condensing worm. These light spirit vapours will travel an immense distance in a 2 or 3 inch pipe without condensing, even if quite cold. They are ultimately arrested in the oxide purifier by the scrubbing action to which they are there submitted. They can, however, be easily and profitably arrested by passing them through a simple form of washer containing heavy oils as already mentioned.

The still gases were formerly treated in oxide purifiers at two of the works, but this method has recently been discarded at Work No. 2266, and treatment by combustion under the boiler fires substituted, with improved results. The gases are exhausted from the receivers by steam suction, passed through a condensing worm (water cooled), and are then washed in heavy oil before passing on to the fire. The draught on the receivers is much improved, and the smell always noticeable in the vicinity of the purifier is of course obviated. Oxide purification continues to be used at the other work as fear is still entertained of fire and explosions. This danger, which was so much dreaded when the combustion method was first mooted, has had no reality in practice. The precautionary measures necessary to insure safety are so simple, and yet effective in practice, that it is strange any objection to the method should still exist. Among the chief improvements effected during the year are the following:—A set of eight stills usually employed for rectifying purposes, but occasionally for distilling tar, at Work No. 2146, have been fitted with appliances similar to those already in use in the tar works for dealing with the gases evolved. The rectifying stills at Work No. 2122 are also now provided with efficient means for dealing with the gases. The appliances adopted towards the end of 1893 at some of the smaller works were not entirely satisfactory when last reported on, but these have now all (with one exception) been brought to a satisfactory state of efficiency. The exception is that of Work No. 2185, which was distinguished as being the least satisfactory tar work in the district, and I fear that in spite of some improvement it still holds that position. Until comparatively recently the stills were finished by fire heat alone, and the sources of possible nuisance were thereby greatly augmented by the amount of distinctive distillation taking place in the stills. The process of distillation has been so far modernised that steam is now used during the final stage, and with very beneficial results in every way. The grave nuisance arising from the fumes given off from the very hot pitch has been now greatly reduced, and the temperature of the pitch at the time of

District No. 7—*continued.*

emptying the stills is some 200° to 300° Fahrenheit less than was formerly the case. Considerable difficulty was experienced in persuading the proprietors to modify their process of manufacture in any particular, but ultimately some improvements were introduced. These consist of provision and use of steam for draughting and distillation purposes, replacement of wooden barrel distillate receivers by iron tank receivers, and erection of pipes for draughting gases and fumes from the receivers and pitch coolers to still or boiler fires. The pitch is now softened in the stills instead of in the pitch receivers, and the latter are provided with an iron curtain on the principle of the French cooler, so that the fumes are sealed and can be drawn away to the fire while the pitch flows under the curtain, as required, into the dipping well, from which it is ladled into barrels. The draughting pipes for dealing with the gases were erected and put in use before steam was employed for the distillation of anthracene, and although the character of the gases now evolved are less objectionable than formerly, the volume of gas to be dealt with is augmented by the steam passing the condensing worms during the anthracene stage, so that the draughting means are now no longer adequate, and considerable improvement in this respect is still necessary.

One work (No. 2101) still remains unprovided with any means for treating the gases evolved. The exceptional difficulties existing in this case, due to the character of the tar treated, were explained in the last Report. Considerable attention has been given to these difficulties, and the proprietor of the work has readily acted upon suggestions given as to means which might possibly overcome the difficulties and dangers which undoubtedly existed. He has gone to very considerable expense to carry out these suggestions, which in practice appear to be entirely successful. The danger of trapping or enclosing the worm end by a syphon bend or receiving tank now being removed, promise has been made that the gases evolved shall be collected and treated by one of such methods as are now in general use, and the appliances for this purpose will be erected at the close of the present busy season.

The distillation of tar by Mr. Lennard's continuous still has been successfully carried on. The original still has been working smoothly and well during a great portion of the year. In the summer it was idle for some time owing to the scarcity of tar at that period of the year, but for the last four months it has been constantly at work, distilling an average of 15,000 gallons per 24 hours. A second and larger still was completed in the autumn, and has been put in operation, and is working in a most satisfactory manner. All the tar obtainable for the works in London belonging to the firm with which Mr. Lennard is connected, will in future be distilled by this system. After another year's acquaintance with, and observation of this system, I feel sure that great possibilities are before it. That it will entirely replace the intermittent process of distillation is not probable, as small distillers must always exist in localities which do not produce tar in quantity, but there is every reason to believe that this process will ultimately, and in the near future, replace the intermittent system in large works. The absolute freedom of the process from any evolution of nuisance, which is so characteristic of the tar distilling industry, is one of its many remarkable advantages, a feature likely to be appreciated by sanitary and other authorities, as well as by the public at large.

F. Napier Sutton.

London, January 1895.

ALKALI, &c. WORKS IN SCOTLAND.

REPORT FOR THE YEAR 1894.

TO THE RIGHT HONOURABLE SIR G. O. TREVELYAN, BART., M.P., HER MAJESTY'S SECRETARY FOR SCOTLAND.

SIR,

I HAVE the honour of presenting my Report of the work that has been done in Scotland under the provisions of the Alkali, &c. Works Regulation Act during the year 1894.

The number of works registered under the Act has remained nearly unchanged, but the work carried on in them was diminished by the effect of the recent strike among the colliers, and by the consequent diminution of trade. The inspection of the registered works has been carried on with regularity, and no serious cases of infringement of the Act have been reported.

The details of the work done in this respect, and some statistics that are of interest, are given by Mr. Curphey, the district inspector, in his report as follows:—

W. S. CURPHEY, Esq., F.C.S., F.I.C., Inspector.

The number of works in Scotland registered under the Alkali Acts for the year ending 31st December 1894 was 126, being one less than in the preceding year. Of these, 12 were "alkali" works, and in the remainder one or more of the various manufacturing processes enumerated in the schedules appended to the Acts are carried on.

The separate processes under inspection, while remaining the same as last year, show several alterations in detail. These processes are as follows:—

	1894.	1893.
Alkali	12	12
Muriatic acid	1	4
Copper extraction	2	2
Sulphuric acid	26	27
Chemical manure	45	44
Nitric acid	7	9
Salts of ammonia	61	59
Chlorine	9	8
Venetian red	2	2
Nitrate of iron	3	5
Bisulphate of carbon	1	1
Tar	39	35
Total	208	208

The following statement shows the quantities of those materials used which are more directly associated with the formation of noxious gases or vapours, and of some of the products manufactured from them :—

QUANTITIES OF RAW MATERIALS AND PRODUCTS.

		1894.	1893.
Salt decomposed—	Tons.	Tons.	Tons.
Alkali works	26,679		
Copper extraction works	3,360	30,039	41,370
Pyrites burned		82,631	87,678
Brimstone		2,951	2,669
Bones and phosphates dissolved		53,252	51,785
Bleaching powder made		6,850	10,441
Sulphate, &c. of ammonia made—			
Iron works	9,675		
Shale works	32,891		
Gas liquor works	11,447	54,013	48,510
Nitric acid made		4,039	2,956

In the course of inspection 523 visits were paid, and 322 examinations made of the gases passing into the air from the various works.

The general average escape of muriatic acid from all the alkali works was 0·092 grain per cubic foot of chimney gases, equivalent to an escape of 2·81 per cent. of the total quantity produced.

The general average escape of acid gases from all the sulphuric acid works was equivalent to 1·79 grain sulphuric anhydride per cubic foot of total gases escaping from the sulphuric acid plant.

ALKALI WORKS.

The number of this class of works was 15, being one less than last year. Two works were removed from the register and one added.

The coal strike, prolonged beyond expectation, had a serious effect on Scottish manufactures, and the alkali works, where so much fuel is used, felt the consequences severely. The greater number ceased operations during its existence, and even at the end of the year all have not yet returned to active work. This state of matters has had a direct effect in curtailing the year's production as indicated in the tabulated statement given above.

The deposit of vat waste at the several works has been carefully attended to, and no annoyance has been observed to arise from it, nor has any complaint been received. This absence of complaint or annoyance is in contrast to the experience of some localities, and the adoption of means for removing the sulphur present in the waste, in order to render it less noxious, has never become a pressing question in Scotland where, partly for this reason, no such process is in operation. The question of waste drainage also is of limited importance. At St. Rollox, where for many years there has continuously been a considerable drainage from the immense accumulations of alkali waste, the results of

operations extending over considerably more than half a century, much expense has been incurred in order to strictly confine the surface drainage to certain channels which conduct it to a collecting pond, where it is stored for use within the works. None of this surface drainage is allowed to flow away. Another portion of drainage which has its source in a spring rising through the ground beneath one of the waste heaps is in large measure still allowed to flow into the River Clyde, but here new pipes of large bore have been laid, and every care taken to conduct it through the City of Glasgow without nuisance. The amount of pollution of the river from this source is steadily diminishing as the continued constant action of the spring water leaves less to be dissolved away, and the outflowing water is gradually becoming less charged with impurities. Part of this dilute drainage is also utilised to supplement the stronger liquor obtained from the surface of the heaps, this latter not being sufficient in quantity to meet the requirements of the works.

The pollution of the River Clyde has long been a subject of consideration to the citizens of Glasgow. Many suggestions and repeated reports have been made, chiefly with regard to the treatment of the sewage, which is the main contamination. Recently large precipitation appliances have been erected and put in operation for dealing with a section of this sewage and purifying it prior to its gaining access to the river.

For many years, however, a species of haphazard sewage precipitation has been going on in that part of the river close to Glasgow. Chemical waste liquors, such as those coming from the heaps referred to, have been mingling with others of a different nature, such as those coming from copper extraction works, galvanizing works, &c., and by mutual chemical action, have been forming precipitates in contact with what one may be pardoned for calling the dilute sewage in Glasgow harbour. In this manner some little good must have come out of these evil liquids, but how much it is difficult to say. By their mutual action on the sewage itself, before dilution with the whole of the river water, much more good would result.

The use of plus-pressure furnaces for decomposing salt has not yet become universal in Scottish alkali works, but after this year no work of any size will be without this type of furnace to perform a portion at least of its operations.

At Irvine, one of the most visible results of activity in the chemical works there has always been the large volumes of steam driven off from the pots used in boiling down the liquors produced in the caustic soda manufacture. The quantity of water so disposed of is very great. At one of the works a great improvement has been effected in materially reducing the amount of escaping steam by the use of a "multiple effect" evaporator. In this apparatus the steam rising from liquor boiling under a certain pressure is used to boil other liquor exposed to less pressure, being itself partly condensed in so doing. This may be carried on for several stages, there being less pressure on the boiling liquid at each stage. This method is at once economical in reducing the consumption of fuel and desirable by reducing the large volumes of vapour which render the atmosphere obscure, especially in damp weather.

The new method of making bleaching powder from chlorine obtained, by means of the oxidising action of nitric acid upon muriatic acid, has continued in an experimental condition throughout the year. Many alterations were made to improve details of the working plant, and, latterly, bleaching powder in some quantity was made. Much escape of acid gases, however, occurred, and operations have been entirely stopped for a time. In the event of resuming the process, further precautions are absolutely necessary to avoid a repetition of such escape.

In Work No. 42 an excessive escape of muriatic acid was observed on two occasions. No prosecution was advised, as the appliances for condensing the gas were greatly improved in order to prevent the recurrence of any cause for complaint. The improved system has worked very satisfactorily. Formerly, the gases from the decomposing furnace passed direct to the condensing tower after being partly cooled in flowing through

earthenware pipes in the ordinary fashion. Now the gases are, before reaching the tower, led into four store cisterns in succession, where they meet the acid liquid coming from the tower. This acid liquid also passes through the four stone cisterns in succession, but in a direction opposite to that in which the gases proceed. In this way some of the acid is condensed, and much of the heat generated when muriatic acid comes in contact with water is dissipated before the tower is reached by the acid gas. At the same time, the strength of the liquid acid in the stone cisterns is increased, so that a weaker acid may be allowed to leave the tower and yet a sufficiently strong product be obtained.

The advantage is thus threefold, less work is left for the condensing tower to do, the temperature of the tower is reduced, and, weaker acid being permissible in the tower, its power of absorbing the gas is greater. An improved mode of supplying and distributing the water at the top of the condenser is in course of construction. When this is completed a further improvement in results may be looked for.

The following tabular statement shows the results of the examinations of acid gases made during the year:—

AVERAGE RESULTS OF TESTS MADE IN ALKALI WORKS DURING THE YEAR ENDING 31ST DECEMBER 1894.

Register Number of Work.	Number of Furnaces usually at work.	Muriatic Acid escaping per Cubic Foot of Chimney Gases.	Acidity of Chimney Gases in Terms of Sulphuric Anhydride per Cubic Foot.	Acidity of Gases passing from Vitriol Plant in Terms of Sulphuric Anhydride per Cubic Foot.
No.	No.	Grains.	Grains.	Grains.
42	3	0·120 0·082	0·82 0·76	0·58
47	1	0·050	0·45	1·81
115	2	0·052	0·80	1·21 1·18 1·32
37	2	0·040	0·42	1·65 1·23
48	1	0·150	0·78	1·40
104	12	0·092	0·88	—
101	1	0·087	—	1·40
43	3	0·091	0·70	—
103	7	0·096	0·64	1·31
30	2	0·085	0·54	1·69
46	3	—	—	2·20
94	1	0·050	0·62	2·30
Average	—	0·092	0·70	1·64

SULPHURIC ACID WORKS.

The standard of efficiency in these works was maintained during the year. In two works an excessive escape of acid gas was observed, both due to accidental causes and of short duration. In one case, the bursting of a steam pipe interfered with the regular working of the chambers and disorganised them for some hours. In the other, owing to a leak in one of the cisterns on the top of the Glover tower the chambers were without the benefit of its use whilst the necessary repairs were being effected. Although an increase was made in the nitrate of soda used, the chambers got temporarily out of condition. There has continued in some of the

works an escape of acid gases from the working doors of the burners, due to insufficient draught. To effect improvement in this matter two Glover towers of improved design have been built to supersede two of an older and less efficient form, and one Glover tower has been repacked, but there still remains some low level escape, when the doors of the pyrites burners are opened.

The severe gale which swept over the country towards the end of December blew down the vitriol chamber at a small work. It is still uncertain whether the damage done will be made good or whether the manufacture will be stopped permanently.

A novel method of decomposing nitre in the vitriol manufacture has been in experimental operation in Work No. 37. The nitrate of soda is mixed with lime and subjected to the action of a current of steam whilst heated by the gases coming from the pyrites burners. The charge of nitrate and lime is contained in a closed vessel to prevent contact with the sulphurous gases. The products of the decomposition are nitric acid, nitrous gases, and caustic soda with lime. In this way the formation of "nitre cake" is avoided, and the soda of the nitrate is obtained in a valuable form. The decomposition would appear to be practically complete if sufficient time be allowed. The results, so far, are encouraging, and further experience is being gained by continued operations.

The following table shows the results of the year's testings in these works:—

AVERAGE RESULTS OF TESTS MADE IN SULPHURIC ACID WORKS DURING THE YEAR ENDING 31ST DECEMBER 1894.

Register No. of Work.	Acidity of escaping Gases, reckoned as Grains SO_3 per Cubic Foot.			Source of Sulphur burned.
	Maximum.	Minimum.	Average.	
119	16·00	0·80	2·48	Pyrites.
112	2·20	1·20	1·61	,,
102	2·20	1·20	1·70	,,
42	0·80	0·30	0·58	,,
25	2·60	0·96	1·78	,,
	2·20	1·12	1·51	
	3·20	2·40	2·80	
47	2·80	1·20	1·81	,,
19	2·96	1·90	2·42	Sulphur.
37	2·10	1·20	1·65	Sulphur and pyrites.
	1·80	0·90	1·23	
48	1·70	1·40	1·60	Pyrites.
45	1·80	0·96	1·55	,,
101	2·20	1·20	1·69	,,
121	2·70	1·60	2·15	,,
122	1·60	0·84	1·21	,,
	2·80	1·12	1·77	
117	4·60	0·80	2·03	,,
44	2·60	0·40	1·62	,,
66	2·00	0·96	1·58	,,
20	1·60	0·80	1·27	,,
103	1·80	0·88	1·31	,,
30	2·40	1·20	1·69	,,
46	2·20	2·20	2·20	,,
116	3·90	1·28	2·71	,,
52	2·80	2·40	2·60	Sulphur.
94	3·80	1·60	2·30	,,
118	5·30	1·20	2·32	Pyrites and sulphur.
	1·04	0·32	0·78	
	1·28	0·96	1·12	
General average	2·90	1·18	1·79	—

Chemical Manure Works.

The number of this class of work was increased from 44 in 1893 to 45. The general condition remained much the same as in the preceding year.

In Work No. 69 an insufficient draught on the mixer caused some local escape of gas. An additional flue was provided to draught the mixer and dens more efficiently. This effected an improvement in the neighbourhood of the former escape, but the volume of the gases to be washed has been increased whilst the proportion of acid in them has been lessened. This has rendered their proper treatment more difficult, and an alteration in the washing arrangements will be necessary.

The following statement shows the results of tests made :—

Average Results of Tests made in Chemical Manure Works during the Year ending 31st December 1894.

Total Acidity expressed as Grains SO_3 per Cubic Foot.

Register No.	Before entering Wash Tower.	After leaving Wash Tower.	Percentage of Acid Absorbed.
29	—	Nil.	100·0
1	1·60	0·24	85·0
67	2·40	0·08	96·7
25	4·40	0·16	96·4
50	2·48	0·16	93·5
70	0·64	0·08	87·5
97	1·60	0·32	80·0
45	1·80	0·40	77·8
44	1·60	0·40	75·0
66	3·12	0·08	97·4
3	2·80	0·16	94·3
60	1·80	0·08	95·6
89	1·76	0·12	93·1
Average	2·14	0·19	90·2

Sulphate of Ammonia Works.

The number of works of this class is now 61, an increase of two over 1893. The production of salts of ammonia shows also an increase over the figure for the preceding year. This increase would have been much more marked but for the prolonged coal strike, which caused a great restriction of operations for the time amongst the iron smelting works, and in a less degree affected also the shale distillation works. In both of these groups of works the recovery of ammonia, &c., from what at one time were entirely waste products, has become a most important item in their operations. But for this economy in most cases the manufacture could not be pursued profitably.

The treatment of the noxious gases incidental to the working of gas liquor continued as formerly. The use of the continuous still continues to extend. In two gas liquor works the old intermittent system has given place to the continuous, and in the new works, added to the list of those registered, the continuous mode of distillation is adopted.

In several of the very small works these gases are burned, in the remainder the oxide of iron purifier is used save in two cases, where all the sulphuretted hydrogen is converted into sulphide of iron before the liquor is distilled.

Tar Works.

The three methods of dealing with the noxious gases given off during the distillation of tar, mentioned in the report for last year, continued in operation. These are destruction by fire, absorption in hydrated lime, and absorption in hydrated oxide of iron.

The method of burning is that in most frequent use, and was in operation in 11 works. This is effective in destroying the sulphuretted hydrogen as such, but permits all the sulphur to escape into the air as sulphurous acid. In five of the iron works a modified method of destruction by fire was in use. There is always a certain proportion of ammonia present in the waste gases, and in order to prevent the loss of this the whole is led back into the gases leaving the blast furnaces, and undergoes with them the processes of scrubbing and washing. Any ammonia coming from the tar stills is thus recovered, whilst those gases which are not removed pass on with the washed gases and are duly burned with them as fuel.

The next method in order of frequency is the lime purifier. There being little carbonic acid in the gases to be dealt with, the lime is effective in arresting the sulphuretted hydrogen and retaining it in the solid form, thus entirely preventing its escape into the air. The lime from time to time requires to be renewed, but not with troublesome frequency. This form of purifier was in operation in nine works and does its work satisfactorily.

In those works where oxide of iron is used sulphate of ammonia also is manufactured, and the noxious gases from the tar department join the gases from the ammonia plant on their way to the purifier. This method also works well and removes the possibility of fire, which may exist when a purifier with oxide of iron is used for the tar gases alone.

Venetian Red Works.

No change has occurred in the number of these works. The two in operation last year have continued at work. That in which the acid gases are kept apart from the fire gases, and are utilized in sulphuric acid chambers, caused no complaint. The other, in which a kiln is used for roasting the copperas, was the subject of a complaint on the part of the local authority, who instituted legal proceedings against the proprietors. These proceedings are not yet definitely terminated, an appeal having been made against the decision of the lower court.

The wash tower in use in this work to prevent an undue escape of acid gas into the air continues to use up the scrap iron with which it is packed. The liquor obtained from it is used for making a colouring matter by the precipitation of the iron in solution.

An improved system of distributing the water over the top of the tower has been put into operation, and the proprietors are ready to make any improvement which experience in working may indicate. Larger flues and altered fire-places are being provided to facilitate the working of the furnace. Hitherto the heating has been very slow, and much time has been spent in working off a charge; this, however, has had the advantage of making the evolution of acid to be correspondingly gradual. The acidity of the escaping gases was found to vary from 3·38 grains SO_3 per cubic foot (with old system of water distribution) to a minimum of 0·24 grains SO_3 per cubic foot. These tests were made on the gases before they reached the chimney, and the minimum figure is below that of ordinary smoke.

W. S. Curphey.

January, 1895.

I am glad to report that there have been no prosecutions under the Alkali Act in Scotland during the past year. It will be seen from the foregoing that although there have been no serious

causes of complaint arising from the various works, that has largely been the result of the continual inspection that has been exercised. Such works are, from the nature of the processes carried on, liable to change and irregularity, and it is acknowledged by the managers that they are greatly indebted to the critical eye of the Government inspector for assistance in detecting and avoiding evils that might otherwise have been overlooked until too late.

It is satisfactory to observe, that while the legal limit of the amount of muriatic acid gas that may escape from an alkali work is 5 per cent. of that produced, the amount actually found to be escaping has been but 2·81 per cent. This is the average amount from all the works during the year. Or, taking the measurement of the same gas in another way, the legal limit is 0·2 grain HCl per cubic foot of the gases passing into the air through the chimney of the work. The amount found by experiment has been only 0·092 grain HCl per cubic foot of chimney gas. This is the amount found on taking the average of all the observations made in the various works throughout the year.

It will be noticed that the number of alkali works and the amount of alkali produced in Scotland is gradually decreasing. This is the case also in England as regards the Leblanc soda process. Several causes contribute to this result. First, a rival soda process, that by the use of ammonia, has of late years become a formidable competitor, and is now the means of furnishing nearly one half of all the soda that is produced. Secondly, Britain is no longer the almost exclusive home of the soda industry, but the works on the continents both of Europe and America take a large share of the world's trade. Thirdly, during the past two years a great falling off in the soda manufacture was experienced, both here and in England, in consequence of the strike among the coal miners. This not only retarded produce, by raising the price of coal, but it diminished the demand for soda by the general crippling of trade and the poverty caused by it.

One fatal accident has occurred at an alkali work at Irvine owing to the use of tank-waste as a foundation or flooring, over which had been erected tanks for the condensation and storage of muriatic acid. This material consolidates into a hard mass, and is not unfrequently used in alkali works for filling up hollow places and making good the ground level. It is hoped that the use of this material will be avoided in future in places where it is possible that acid liquors may come in contact with it. In this case a bricklayer having to effect some repair to pipes connected with these acid tanks was overcome by a rush of sulphuretted hydrogen gas caused by an overflow of the muriatic acid on to the bed of tank-waste below. The bricklayer fell to the ground insensible, and could not be recovered.

The new process of Mr. Donald, for the manufacture of bleaching powder from chlorine produced by the action of nitric acid on hydrochloric acid, has made some progress during the past year, but it is still in the experimental stage.

The demand for nitric acid derives great stimulus for the manufacture of nitro-glycerine, gun cotton, and other explosives. Important improvements have been introduced at the works for its production.

I have the honour to be,
Sir,
Your most obedient Servant,
March 1st, 1895. ALFRED E. FLETCHER.

REPORT

TO THE

SECRETARY OF THE BOARD OF TRADE

UPON THE

WORKING OF THE BOILER EXPLOSIONS ACTS, 1882 AND 1890,

WITH

APPENDICES.

(*In continuation of Parliamentary Paper* C.—7489.)

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
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1895.

[C.—7856.] *Price* 3*d*.

Report on the Working of the Boiler Explosions Acts, 1882 and 1890, during the year ended June 30, 1895.

THIRTEENTH REPORT.

TO THE SECRETARY OF THE BOARD OF TRADE.

During the 12 months ended 30th June 1895, 87 preliminary inquiries and 27 formal investigations were held under the provisions of the Boiler Explosions Acts, 1882 and 1890.

The following summary shows the finding of the Court in those cases in which formal inquiries were ordered :—

Report No.	Finding of Court.	Order as to Costs.
773	An employé blamed for interfering with the safety-valve without authority.	No order made.
778	Owner blamed for neglect	Owner to pay 20*l.* towards costs.
782	Feed-system imperfect, but no blame imputed to any person.	No order made.
786	Owners blamed for neglect	Each of the owners (2) to pay 10*l.* towards costs.
788	Boiler-maker who advised as to working-pressure blamed	Boiler-maker to pay 10*l.* towards costs.
790	No person blamed	No order made.
791	User showed want of skill in management of boiler	No order made.
796	User blamed for neglect	User to pay 10*l.* towards costs.
803	Owner blamed for neglect	Owner to pay 65*l.* towards costs.
806	No person blamed	No order made.
807	Manager blamed for neglect	Owners to pay 20*l.* towards costs.
808	Owner blamed for neglect	Owner to pay 25*l.* towards costs.
816	Owners blamed for placing their boilers under the supervision of a person not properly qualified.	Owners to pay 40*l.* towards costs.
819	Owners blamed for having no proper superintendence over the boiler and for gross mismanagement.	Owners to pay 90*l.* towards costs.
844	Owner blamed for neglect	Owner to pay 10*l.* towards costs.
853	Owners blamed for laxity of management	Owners to pay 10*l.* towards costs.
855	Owner blamed for neglecting to have proper inspection made and to obtain advice as to safe working-pressure.	Owner to pay 25*l.* towards costs.
856	Owner blamed for neglect	No order made (owner was severely injured by explosion).
860	Broker who sold the boiler, engineer who advised the owner as to purchase, and owner blamed.	Broker to pay 10*l.*, and the engineer and owner each to pay 5*l.* towards costs.
861	No person blamed	No order made.
863	Owners blamed slightly for not taking full precautions	Owners to pay 42*l.* towards costs and Board of Trade 7*l.* 7*s.* to two witnesses.
864	Owner blamed for recklessness	Owner to pay 20*l.* towards costs.
865	Makers blamed for omitting to give explicit instructions as to use of apparatus, and engineer who repaired it blamed for fitting an inefficient safety appliance.	Makers to pay 30*l.* and engineer 5*l.* towards costs.
873	Owners and insurance company both blamed	Owners to pay 200*l.* and the insurance company 50*l.* towards costs.
874	Boiler-maker who advised users blamed	Boiler-maker to pay 10*l.* towards costs.
875	Owner blamed for negligence	Owner to pay 15*l.* towards costs.
876	Owner blamed for negligence	Owner to pay 12*l.* towards costs.

During the 12 months 43 persons were killed and 85 persons injured by boiler explosions. The total number of cases inquired into shows a small increase upon that of the preceding year, and the number of persons killed, as also the number of persons injured, is larger than in any year since the Boiler Explosions Act of 1882 came into force. During last year, however, several exceptionally serious cases were dealt with, more than half the total number of deaths having resulted from four explosions.

In one case (No. 873), at the Redcar Iron Works, 12 boilers, each about 66 ft. in length and 4 ft. 6 ins. in diameter, were destroyed and thrown broadcast about the works, killing twelve men and injuring eight. Moreover, the year 1894–95 was remarkable for a period of exceptionally severe frost, and one result of this was an unusual number of explosions of boilers used for heating public buildings and places of business. There were 27 cases of this kind dealt with, and with three exceptions they were probably caused by the freezing of water in some part of the apparatus. Leaving out of question the exceptional cases and the considerable number of cases in which the explosions were of a slight character, it will be seen that the figures for the year do not show that there is any increase as regards laxity of management or inspection on the part of steam users or boiler insurance companies, or that there is any general increase in the number of serious boiler explosions.

Appendices are attached giving particulars of the cases dealt with, classifications of the causes of explosions, and of the types of boilers which exploded, together with statistics of the numbers of persons killed and injured since 1882, and a Report from the Board's Solicitor on the formal investigations held.

INGRAM B. WALKER,
Assistant Secretary.

Board of Trade,
Marine Department,
January 1896.

APPENDIX A.

Boiler Explosions Acts, 1882 and 1890.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895.

No. of Report, Place of Explosion, and Owner of Boiler.	Date of Explosion.	Persons killed.	Persons injured.	General Description and age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
764.									
"Marquis of Lorne," S.S., O.N. 65,005; Mr. H. Burden, junr.	3 July 1894	—	—	Cylindrical multi-tubular. 18 years.	Shell - -	Supplying steam to propelling machinery.	Not inspected or insured by any company or association.	External corrosion - -	Preliminary inquiry only.
765.									
Darwen; Messrs. Bogle and Hindley.	2 July 1894	—	—	Sheet iron cylinder, forming part of "slasher" sizing machine. 10 years.	Do. - - -	Drying cotton warp.	Do. - - -	Over-pressure, safety-valve inoperative.	Do.
766.									
Rhymney; the Rhymney Iron Co.	13 July 1894	—	—	Locomotive type - 31 years; re-built 6 years ago.	Barrel - - -	Drawing coal waggons.	Do. - - -	Grooving at longitudinal seam	Do.
767.									
"Metal," S.S., O.N. 104,542; Messrs. W. Jacks & Co.	15 July 1894	—	—	Main steam pipe of copper. New.	Pipe close to flange -	Conveying steam to propelling machinery.	Lloyd's - - -	Insufficient provision to meet the stresses set up by vibration.	Do.
768.									
"Forester," Smack; O.N. 95,691; Mr. W. H. Painter, senior.	1 Aug. 1894	—	—	Vertical - - 6 years.	Crown-plate of shell -	Working trawl gear, &c.	Not inspected or insured by any company or association.	Internal corrosion - -	Do.
769.									
"Poppy," Yacht; O.N. 97,737; Mr. A. Hodge.	14 July 1894	—	—	Cylindrical multi-tubular. 3 years.	Joint of man-hole door -	Supplying steam to propelling machinery.	Do. - - -	The use of jointing material of improper section and imperfect design of man-hole door.	Do.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued.*

No. of Report, Place of Explosion, and Owner of Boiler. 1.	Date of Explosion. 2.	Persons killed. 3.	Persons injured. 4.	General Description and Age of Boiler or Vessel which exploded. 5.	Part of the Boiler which gave way. 6.	Purpose for which Boiler was used. 7.	Whether inspected or insured by any Company or Association, &c. 8.	Cause of Explosion. 9.	General finding of Court if a Formal Investigation held. 10.
770.									
"Better Luck," Smack; O.N. 92,938; Mr. G. Lawson.	10 Aug. 1894	—	—	Vertical, with two cross tubes. 4 years.	Lower cross tube -	Working trawl gear, &c.	Not inspected or insured by any company or association.	Over-heating, due to accumulation of deposit.	Preliminary inquiry only.
771.									
Chelmsford; Mr. F. Remnant.	10 Aug. 1894	—	—	Vertical - - 11 years.	Firebox - - - -	Working a chaff-cutter, &c.	Do. - - -	External corrosion - -	Do.
772.									
"Iron King," S.S., O.N. 94,035; Mr. R. Simpson.	9 Aug. 1894	—	—	Main steam pipe of copper. New.	Pipe close to flange -	Conveying steam to propelling machinery.	Lloyd's - - -	Pipe too rigid. (This was the fourth time it had failed.)	Do.
773.									
Dudley; Messrs. Cochrane & Co.	27 July 1894	1	4	Vertical - - Age uncertain.	Shell-plate near firehole -	Driving a circular saw.	Not inspected or insured by any company or association.	Undue pressure, the safety-valve having been rendered in-operative.	The valve was screwed down by an employé who interfered without any authority, and no order was made as to costs.
774.									
"Briton," S.S., O.N. 83,852; Falmouth Towage Co., Ltd.	26 Aug. 1894	—	—	Multitubular - - 14 years.	One of the tubes - -	Supplying steam to propelling machinery.	Lloyd's - - -	Pitting and defective material	Preliminary inquiry only.
775.									
"Cornhill," S.S., O.N. 97,958; Warkworth Shipping Co., Ltd.	15 Sept. 1894	—	—	Main steam pipe of copper. 3 years.	Pipe close to flange -	Conveying steam to propelling machinery.	Do. - - -	Pipe too rigid to allow for movement of machinery.	Do.
776.									
"Dunvegan;" O.N. 87,741; Smith S.S. Co., Ltd.	9 Sept. 1894	—	—	Cylindrical multitubular. 11 years.	Bottom of starboard combustion chamber.	Supplying steam to propelling machinery.	Do. - -	Corrosion of plate - -	Do.

777.									
"Nell," barge; Leeds and Liverpool Canal Co., Ltd.	8 Sept. 1894	—	1	Vertical, with Field tubes. 4 years.	One of the Field tubes -	Do. - -	Engine Boiler and Employers' Liability Insurance Co., Ltd.	Over-heating through accumulation of scale.	Do.
778.									
Near Peterhead; Mr. J. Forrest.	6 Aug. 1894	—	2	Locomotive type - 11 years.	Feed check-valve chest -	Working a road traction engine.	Not inspected or insured by any company or association.	Threads of screw connecting valve-chest to boiler were worn and loosened owing to the vibration of one of the shafts, the supporting bracket being broken and loose.	Owner blamed for not having a proper inspection made, and ordered to pay 20*l.* towards costs.
779.									
Birmingham; Birmingham Central Tramway Co., Ltd.	2 Oct. 1894	—	1	Locomotive type - 8 years.	Two of the tubes - -	Working a tramcar.	Yorkshire Boiler Insurance and Steam Users' Co., Ltd.	Thinning of tubes owing to wasting action of grit and gases from fuel.	Preliminary inquiry only.
780.									
Lanark; the Lanark Spinning Co.	8 Oct. 1894	1	—	Cast-iron pipe blow-down. 13 years.	Body of pipe - -	Connecting main waste pipes to boiler.	National Boiler Insurance Co.	Undue rigidity of piping, together with local corrosion.	Do.
781.									
Haslingden; Accrington Corporation Steam Tramways Co.	11 Oct. 1894	—	1	Locomotive type - 3 years.	One of the tubes - -	Working a tramcar.	Yorkshire Boiler Insurance Co.	Thinning of tubes from corrosion and abrasion.	Do.
782.									
Oldbury; Messrs. G. Jackson & Co.	30 Aug. 1894	1	—	Cylindrical egg-ended type. Age unascertainable.	Shell - - -	Working brick-making machines.	Not inspected or insured by any company or association.	Over-heating through shortness of water, due to defective feeding arrangements.	The feed-system was imperfect, but no blame was attached to owners, and no order made as to costs.
783.									
"Renown," Paddle-Trawler; O.N. 72,532; Mr. J. Taylor.	14 Sept. 1894	—	—	Flue boiler - - 18 years.	Starboard furnace - -	Supplying steam to propelling machinery.	Do. - -	Over-heating through water having been allowed to become too dense.	Preliminary inquiry only.
784.									
"Speculator," Smack; O.N. 85,243; Mr. S. Legett.	15 Sept. 1894	—	—	Vertical type - 5 years.	Uptake - - -	Working trawl gear.	Do. - -	Internal corrosion - -	Do.

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Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued*.

No. of Report, Place of Explosion, and Owner of Boiler.	Date of Explosion.	Persons killed.	Persons injured.	General Description and Age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
785.									
Bradford; Messrs. T. Priestly and Son.	3 Oct. 1894	—	1	Cast-iron stop valve-chest. 11 years.	Upper part blown off -	To regulate supply of steam to engines.	Yorkshire Insurance and Steam Power Co., Ltd.; and by the Boiler Insurance and Steam Power Co., Manchester.	Impact of water - -	Preliminary inquiry only.
786.									
Salford; Messrs. Renshaw and Dutton.	7 Sept. 1894	—	—	Coruish type - - Age not ascertained.	Shell - - -	Supplying steam to engines which drove works machinery.	Not inspected or insured by any company or association.	External corrosion - -	Owners blamed for not having boiler properly examined, and each of them (2) ordered to pay 10*l.* towards costs. (In this decision regard was had for the heavy losses the owners incurred through the explosions.
787.									
"Iris," Smack; O.N. 93,103; Messrs. Hewett & Co.	27 Sept. 1894	—	—	Vertical type - - 7 years.	Joint of mud-hole door -	Working trawl gear.	Do. - - -	Wasting of the shell-plate, and the use of unsuitably shaped material.	Preliminary inquiry only.
788.									
"Amy," Barge; Mr. R. Abel.	18 Sept. 1894	1	—	Cylindrical multi-tubular. 18 years.	Back end plate of combustion chamber drawn from the stays.	Supplying steam to propelling machinery.	Do. - - -	Corrosion of the plate threads of one of the stays.	A journeyman boiler-maker who advised the owner to fix a working-pressure too high for the boiler was blamed; but having regard to his limited means, he was ordered to pay only 10*l.* towards costs.
789.									
"Beta," S.S., O.N. 65,262; Mr. R. D. Purvis.	13 July 1894	—	—	Cylindrical multi-tubular. 14 years.	Joint of man-hole door -	Do. - -	Do. - - -	Corrosion of the spigot of the door.	Preliminary inquiry only.
790.									
Stoke-upon-Trent; Mr. J. Aynsley.	15 Aug. 1894	1	—	Cast-iron steam pipes	India-rubber joint - -	Conveying steam to engines.	Do. - - -	The india-rubber had perished	The Court recommended the use of more durable material, but made no order as to costs.
791.									
Castleblaney, Monaghan; Lord F. P. Clinton Hope.	18 Sept. 1894	—	2	Cornish type - - Over 20 years.	Flue - - -	To drive engine at coach-maker's works.	Do. - - -	Undue working-pressure -	The Court thought the user of the boiler, who rented it with premises, showed a want of skill in its management, but they made no order as to costs.

792.									
Glasgow; Messrs. McAlpine and Sons.	16 Oct. 1894	—	1	Vertical type - 2 years.	Firebox - - -	Working brick-making machine.	Scottish Boiler Insurance Co.	Over-heating through shortness of water.	Preliminary inquiry only.
793.									
"Swift," Smack; O. N. 99,581; Messrs. Hewett & Co.	9 Sept. 1894	—	—	Vertical type, with 18 cross tubes in firebox. 2 years.	4 cross tubes - -	Working trawl gear.	Not inspected or insured by any company or association.	Over-heating through accumulation of salt.	Do.
794.									
"Harrier," Trawler; O.N. 86,145; Mr. W. Decent.	31 Oct. 1894	—	—	Vertical type - - 5 years.	Bolt broken which secured a plate over an old defect in uptake.	Do.	Do. - -	Inefficient mode of repair -	Do.
795.									
"Pride o' Scotland," Tug; O.N. 65,413; Peterhead Steam Towing Co.	23 Oct. 1894	—	—	Return flue type - 23 years.	Uptake - - -	Supplying steam to propelling machinery.	Do. - - -	Corrosion of the uptake -	Do.
796.									
Hagley, Worcester; Mr. J. Amphlett.	10 Oct. 1894	1	—	Cylindrical egg-ended. At least 36 years.	Piece of shell-plating blown out.	Working a grinding mill.	Do. - - -	Corrosion of the plates -	The user of the boiler, who hired it with premises, was blamed for neglecting to have it examined, and was ordered to pay 10*l.* towards costs.
797.									
Baxenden; Accrington Corporation Steam Tramways Co.	7 Nov. 1894	—	—	Locomotive type - 7 years.	One of the tubes - -	Working a tram car.	Yorkshire Boiler Insurance Co.	Thinning of tube due to washing action of sulphurous fumes and grit.	Preliminary inquiry only.
798.									
"Ibis," Screw Trawler; O.N. 93,934; Messrs. W. Hamilton & Co.	23 Sept. 1894	—	—	Cylindrical multitubular type. 2 years.	Joint of man-hole door -	Supplying steam to propelling machinery.	Built under Lloyd's inspection.	Imperfectly fitting door -	Do.
799.									
Walisend-on-Tyne; Wallsend and Hebburn Coal Co., Ltd.	29 Oct. 1894	—	—	Receiver of circular section. 26 years.	Receiver became detached	Receiving steam from boilers and distributing it to engines.	Not inspected or insured by any company or association.	Inefficient mode of securing the receiver in its position.	Do.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued.*

No. of Report, Place of Explosion, and Owner of Boiler.	Date of Explosion.	Persons killed.	Persons injured.	General Description and Age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
800.									
"Commonwealth," S.S., O.N. 88,761; Commonwealth S.S. Co.	13, 14, and 15, Sept. 1894.	—	—	Cylindrical multitubular type. 11 years.	Joint of man-hole door	Supplying steam to propelling machinery.	Lloyd's	Door fitted badly, and jointing material unsuitable.	Preliminary inquiry only.
801.									
"Tender," Barge; O.N. 72,452; Messrs. Sully & Co.	28 Sept. 1894	—	—	Cylindrical multitubular type. 8 years.	Do.	Do.	Not inspected or insured by any company or association.	Do.	Do.
802.									
"Afton," S.S., O.N. 76,793; Mr. D. Rowan, junr.	15 Nov. 1894	—	—	Cylindrical multitubular type. 8 years.	Furnace	Do.	Lloyd's	Over-heating through shortness of water.	Do.
803.									
Garston; Messrs. W. Bostock & Co.	29 Oct. 1894	3	8	Copper cylinder with hemispherical ends. 14 years.	Shell and ends	Conversion of meal, &c., into saccharine matter.	—	Undue working pressure	Owner blamed for neglecting to ascertain that the converter was being worked under safe conditions, and ordered to pay 65*l.* towards costs.
804.									
Buckley; Messrs. G. Watkinson & Sons, Ltd.	12 Dec. 1894	—	—	Portable engine type 20 years.	End plate	Hauling waggons.	Not inspected or insured by any company or association.	Weakness of construction	Preliminary inquiry only.
805.									
Brabourne, Kent; Vicar and Churchwardens of St. Mary's Church.	24 Dec. 1894	—	—	Saddle type Nearly new.	Firebox	Heating the church.	Do.	Undue pressure, the boiler being altogether unsuitable for the purpose for which it was used.	Do.
806.									
Darlaston; South Staffordshire Tramway Co.	23 Nov. 1894	1	—	Vertical type. 11 years.	Man-hole door blown out	Working a tram car.	Yorkshire Boiler Insurance and Steam Users' Company.	Unequal strain in screwing up nuts.	The Court thought the material unsuitable, but no blame was attached to the Company and no order made as to costs.

807.									
Ivybridge, Devonshire; Messrs. J. Allen and Sons.	19 Nov. 1894	—	—	Cylindrical receiver - Age not ascertained, but at least 40 years.	One end - - -	Working machinery.	Not inspected or insured by any company or association.	Wasting of heads of rivets securing stay-bracket to end plate.	Manager blamed for negligence; owners held responsible and ordered to pay 20*l.* towards costs.
808.									
Stanford-le-Hope; Mr. C. Spencer Boorman.	1 Dec. 1894	—	1	Cornish type - - 27 years.	Flue - - -	Working flour mill machinery.	Do. - - -	Undue working-pressure and defective condition of flue.	Owner blamed for neglecting to ascertain the pressure at which boiler might have been safely worked, and ordered to pay 25*l.* towards costs.
809.									
Swansea; Graigola Merthyr Co., Ltd.	7 Jan. 1895	—	3	Cast-iron superheater Nearly new.	One of the pipes -	Working pug mills.	Do. - - -	Over-heating, the circulation of steam having probably been stopped.	Preliminary inquiry only.
810.									
Rodley, Leeds; Trustees of the Bethel Baptist Chapel.	11 Jan. 1895	—	—	Saddle type - - 2 years.	Shell parted from firebox	Heating the chapel.	Do. - - -	Over-pressure; water in pipes having become frozen.	Do.
811.									
Irlam Locks; Manchester Ship Canal Co.	22 Dec. 1894	1	2	Locomotive type - 6 years. Re-tubed about 1½ years ago.	One of the brass smoke tubes.	Drawing waggons.	Boiler Insurance and Steam Power Co.	Thinning of tubes, due to wasting action of fuel, grit, &c.	Do.
812.									
Hull; Trustees of the Queen's Road Wesleyan Chapel.	8 Feb. 1895	—	—	Small tube, high-pressure type. 5 years.	One of the coils - -	Heating the chapel.	Not inspected or insured by any company or association.	Over-pressure; water in pipes having become frozen.	Do.
813.									
Aberdeen; Aberdeen School Board.	9 Jan. 1895	—	—	Wrought-iron coils of piping. 3 years.	Do. - - -	Heating the schoolroom.	Do. - -	Do. - - -	Do.
814.									
Near Partick, Renfrewshire; Trustees of the Jordanhill Free Church.	17 Jan. 1895	—	—	Wrought-iron coils of piping. 9 years.	Do. - -	Heating the church.	Do. - - -	Do. - - -	Do.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued.*

No. of Report, Place of Explosion, and Owner of Boiler.	Date of Explosion.	Persons killed.	Persons injured.	General Description and Age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
815.									
Crewe; London and North-Western Railway Co.	9 Feb. 1895	—	—	Wrought-iron coils of piping. 8 years.	One of the coils - -	Heating the school.	Not inspected or insured by any company or association.	Over-pressure; water in pipes having become frozen.	Preliminary inquiry only.
816.									
Bridgend, Glamorganshire; North's Navigation Collieries (1889), Ltd.	9 Jan. 1895	3	—	Cylindrical, egg-ended 11 years.	Shell - - -	Working pumping engine.	Do. - - -	External corrosion - -	Owners blamed for placing their boilers under the supervision of a person not properly qualified, and ordered to pay 40*l.* towards costs.
817.									
"Royal Duke," Paddle Trawler; O.N. 68,034; Mr. D. B. Sharp.	21 Dec. 1894	—	1	Flue boiler - - 13 years.	Do. - - -	Supplying steam to propelling machinery.	Total Loss Mutual S.S. Insurance Co., Sunderland.	Do. - -	Preliminary inquiry only.
818.									
Collingbourne, Kingston, Wilts; Vicar and Churchwardens of St. Mary's Church.	9 Feb. 1895	—	—	"Finsbury" type - 1 year.	Firebox - -	Heating the church.	Not inspected or insured by any company or association.	Over-pressure; the outlets being choked by ice.	Do.
819.									
London; Henry Rifled Barrel and Small Arms Engineering Co., Ltd.	17 Dec. 1894	2	10	Tubular Cornish type 13 years.	Shell - - - -	Driving portion of shop machinery.	National Boiler Insurance Co.	Longitudinal seam rip -	The Company were blamed for having no proper superintendence over the boiler and for gross mismanagement, and ordered to pay 90*l.* towards costs.
820.									
Birmingham; Mr. E. C. Piercy.	8 Feb. 1895	—	—	Wrought-iron coils - Nearly new.	One of the coils - -	Heating premises.	Not inspected or insured by any company or association	Over-pressure; the pipes being choked, probably by ice.	Preliminary inquiry only.
821.									
Cross Hills, Yorkshire; Trustees of the United Methodist Free Church School.	10 Jan. 1895	—	—	Vertical heating - 14 years.	Firebox - -	Heating the schoolroom.	Do. - - -	Do. - -	Do.

822.									
Gateshead; Gateshead and District Tramway Co.	29 Jan. 1895	—	1	Vertical, with Field tubes. 11 years.	One of the Field tubes -	Working a tram-engine.	Scottish Boiler Insurance and Engine Inspection Co.	Wasting and over-heating, due to accumulation of deposit.	Do.
823.									
"Carabineer," S.S., O.N. 76,914; Mr. D. McBrayne.	30 Jan. 1895	—	—	Cylindrical multi-tubular. 17 years.	Firebox - -	Supplying steam to propelling machinery.	Board of Trade Passenger Certificate.	Over-heating through shortness of water.	Do.
824.									
Dudley; Trustees of Baptist Chapel.	16 Feb. 1895	—	—	Small tube, high-pressure type. 4 years.	Upper coil - -	Heating the chapel.	Not inspected or insured by any company or association.	Over-pressure; pipes choked, probably by ice.	Do.
825.									
Aberdeen; Aberdeen School Board.	9 Jan. 1895	—	—	Wrought-iron coils - 4 years.	One of the coils - -	Heating a schoolroom.	Do. - - -	Do. - -	Do.
826.									
Heckmondwike; Trustees of the Methodist Free Church.	8 Feb. 1895	—	—	Small tube, high pressure type. 11 years.	Do. - -	Heating the church.	Do. - -	Do. - -	Do.
827.									
Rhynie, Aberdeen; The Deacons' Court. Chairman, Revd. T. Bruce.	9 Feb. 1895	—	—	Wrought-iron coils - 1 year.	Do. - -	Do.	Do. - - - -	Do. - - - -	Do.
828.									
Tamworth; Revd. W. MacGregor.	9 Feb. 1895	—	1	Wrought-iron coils - 10 years.	Two of the coils - -	Heating baths	Do. - - -	Do. - -	Do.
829.									
Port Glasgow; Trustees of the Newark Parish Church.	10 Feb. 1895	—	1	Wrought-iron coils - 11 years.	One of the coils -	Heating the church.	Do. - - -	Do. - -	Do.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued.*

No. of Report, Place of Explosion, and Owner of Boiler.	Date of Explosion.	Persons killed.	Persons injured.	General Description and Age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
830.									
Aberdeen; Messrs. A. Brown & Co.	11 Feb. 1895	—	—	Wrought-iron coils - 2 years.	One of the coils -	Heating the premises.	Not inspected or insured by any company or association.	Over-pressure; pipes choked, probably by ice.	Preliminary inquiry only.
831.									
Hexham; Mr. W. Moffatt.	11 Feb. 1895	—	1	Saddle type - - At least 20 years.	Shell - -	Heating show-room.	Do. - - -	Do. - - -	Do.
832.									
Blackburn; Blackburn and Over Darwen Tramways Co.	19 Feb. 1895	—	—	Locomotive type - 10 years. (Tubes made in 1889) re-tubed 5 years ago).	Plug blown out - -	Working a tramcar.	Scottish Boiler Insurance Co.	Insufficiency of holding-power of plug. - -	Do.
833.									
"Seaham Harbour," S.S., O.N. 81,479; Marquis of Londonderry.	29 Jan. 1895	—	—	Steam-pipe of copper 14 years.	T-piece - - -	Conveying steam to propelling machinery.	Lloyd's - -	Excessive vibration of engines	Do.
834.									
Liverpool; Domestic Mission Society.	8 Feb. 1895	—	—	Tubular heating apparatus. 2 years.	One of the tubes -	Heating the mission hall.	Not inspected or insured by any company or association.	Over-pressure; pipes choked, probably by ice.	Do.
835.									
Leamington; Trustees of the Wesleyan Schools.	6 Feb. 1895	—	2	Wrought-iron coils - 1 year.	One of the coils - -	Heating school-room.	Do. - - -	Do. - - -	Do.
836.									
Dundee; Mr. W. Smith	10 Feb. 1895	—	—	Wrought-iron coils - 8 years.	Do. - - -	Heating hall -	Do. - -	Do. -	Do.

837.									
Tamworth; Rev. W. MacGregor.	22 Jan. 1895	—		Wrought-iron coils - 10 years.	Do.	Do.	Do.	Coils worn out.	Do.
838.									
Brierley Hill; Dudley and Stourbridge Steam Tramways Co., Ltd.	27 Feb. 1895	—	—	Locomotive type - 11 years.	One of the tubes -	Working a tramcar.	Do.	Thinning of tube, owing to wasting action of grit and sulphurous fumes.	Do.
839.									
Belfast; Legal Hundred of the Methodist Connexion in England and Ireland.	10 Feb. 1895	—	—	Tubular heating apparatus. 11 years.	Do.	Heating the church.	Do.	Over-pressure, water in pipe having become frozen.	Do.
840.									
Aberdeen; Messrs. J. Saint & Co.	11 Feb. 1895	—	—	Wrought-iron coils - About 5 years.	One of the coils, also circulating pipes in two places.	Heating the premises.	Do.	Do.	Do.
841.									
"Mary Ellen," P.S.; River Lune Commissioners	20 Feb. 1895	—	—	Multitubular type - 14 years.	Front end -	Supplying steam to propelling machinery.	Engine Boiler and Employers' Liability Insurance Co.	Corrosion, caused by leakage from flange of check-valve.	Do.
842.									
Compstall, near Marple; Trustees of the Primitive Methodist Chapel.	8 Feb. 1895	—	—	Annular conical heating apparatus. 2 years.	Inner tube -	Heating chapel, schools, and classrooms.	Not inspected or insured by any company or association.	Over-pressure, water in pipe having become frozen.	Do.
843.									
"Pioneer," Tug; River Weaver Trustees.	13 Feb. 1895	—	2	Multitubular cylindrical. 2 years. Made in 1889; chest, 5 years.	Safety-valve chest -	Supplying steam to propelling machinery.	Manchester Steam Users' Association.	Weakness of construction -	Do.
844.									
Yeovilton, Somerset; Mr. W. Sparrow.	16 Feb. 1895	2	2	Portable type - - At least 17 years.	Firebox and uptake -	Working a threshing machine.	Not inspected or insured by any company or association.	Corrosion - -	Owner blamed for neglecting to ascertain the condition of the boiler, and ordered to pay 10*l.* towards costs.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued.*

No. of Report, Place of Explosion, and Owner of Boiler.	Date of Explosion.	Persons killed.	Persons injured.	General Description and Age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
845.									
Leith; North Leith Parish Church Hall Committee.	10 Feb. 1895	—	—	Wrought-iron coils - 9 years.	One of the coils - -	Heating a hall	Not inspected or insured by any company or association.	Over-pressure; pipes choked, probably by ice.	Preliminary inquiry only.
846.									
Burnley; the Burnley and District Tramway Co., Ltd.	8 March 1895	—	1	Locomotive type - 10 years.	One of the tubes - -	Working a tramcar.	National Boiler Insurance Co., Ltd.	Thinning of tubes, owing to wasitng action of grit and gases from fuel.	Do.
847.									
Broughty Ferry; Trustees of St. Luke's Church.	13 Feb. 1895	—	2	Wrought-iron coils - 10 years.	Two of the coils - -	Heating the church.	Not inspected or insured by any company or association.	Over-pressure; pipes choked, probably by ice.	Do.
848.									
"James and Martha," Smack; O.N., 67,199; Mr. W. Jeckells.	2 March 1895	—	—	Vertical type - - Probably 5 years.	Shell - - -	Working trawl gear.	Do. - - -	Corrosion, caused by leakage from blow-off cock.	Do.
849.									
"Wild Duck," Launch; Mr. F. Strickland.	27 Feb. 1895	—	—	Water-tube type - New.	One of the tubes - -	Supplying steam to propelling machinery.	Do. - - -	Weakness of the tube and over-heating.	Do.
850.									
"Victor," Tug; O.N. 58,862; Mr. C. C. Duncan.	13 Dec. 1894	—	—	Return-flue type - 25 years.	Bottom of shell - -	Do. -	Do. - - -	Boiler worn out - -	Do.
851.									
"Flying Sprite," P.S., O.N. 60,405; Mr. F. Ness and Mr. T. Sellars.	26 March 1895	—	—	Return-flue type - 17 years.	Uptake - - -	Do. -	Sunderland Mutual Insurance Co.	Local pitting - -	Do.

852.									
Hayfield, Lancashire; Kinder Printing Co.	8 April 1895	—	1	Cast-iron keir Over 20 years.	Lower portion of cylindrical part.	Bleaching cotton material.	Not inspected or insured by any company or association.	Defective condition of lower part.	Do.
853.									
Newport, Mon.; Messrs. Richards and Hopkins.	12 Feb. 1895	—	3	Vertical, with three cross tubes. Age not ascertained.	Firebox	Working machinery.	Do.	Over-pressure, safety-valve inoperative.	Owners blamed for laxity in management of boiler, and held responsible for the neglect of the fireman to test the safety-valve. One of the owners ordered to pay 10*l.* towards costs.
854.									
"Danehill," S.S., O.N. 91,152; Warkworth Shipping Co., Ltd.	9 Mar. 1895	—	—	Main steam-pipe of copper. 4 years.	Solid part of pipe	Conveying steam to propelling machinery.	Lloyd's	Pipe too rigid	Preliminary inquiry only.
855.									
Lochmill, nr. Linlithgow; Mr. C. Chalmers.	5 April 1895	1	—	Cast-iron cylinder, with dished ends. 26 years.	Bottom	Boiling esparto grass.	Not inspected or insured by any company or association.	Boiler too weak for the working-pressure.	Owner blamed for neglecting to have proper inspection made to advise him as to safe working-pressure, and ordered to pay 25*l.* towards costs.
856.									
Little Casterton, Rutland; Mr. A. Broughton.	10 Jan. 1895	—	2	Vertical type 27 years.	Crown of firebox	Chaff cutting and grinding.	Do.	Worn out	Owner blamed for omitting to have the boiler properly examined, but as he was severely injured by the explosion, no order was made as to costs.
857.									
"Phosphor," S.S., O.N. 93,847; Messrs. R. Stewart & Co.	19 Feb. 1895	—	—	Cylindrical multitubular type. 6 years.	Nuts of stays in combustion chamber forced off.	Supplying steam to propelling machinery.	Bureau Veritas	Over-heating, through accumulation of scale.	Preliminary inquiry only.
858.									
"Volana," S.S., O.N. 84,680; Messrs. Bright and Cook.	22 May 1895	—	2	Cylindrical multitubular type. 12 years.	Main feed check valve box.	Do.	Lloyd's	Defective thread in screw of chest and cover.	Do.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued.*

No. of Report, Place of Explosion, and Owner of Boiler.	Date of Explosion.	Persons killed.	Persons injured.	General Description and Age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
859.									
Little Island, co. Cork; Mr. H. W. Fenner.	30 May 1895	—	—	Cornish type - 12 years.	Flue - - -	Supplying steam to stills and machines.	Not inspected or insured by any company or association.	Undue working pressure -	Preliminary inquiry only.
860.									
Cadley, Preston; Mr. G. Wilson.	11 Mar. 1895	—	—	Vertical type - About 20 years.	Firebox - -	Supplying steam to a pump.	Do. - -	Worn out - - -	The metal broker who sold the boiler to Mr. Wilson was blamed for misrepresenting the condition of the boiler, and ordered to pay 10*l.* towards costs. The engineer who advised the owner on the purchase, and the owner, were also blamed, and each ordered to pay 5*l.* towards costs.
861.									
Govan; Messrs. Babcock and Wilcox, Ltd.	1 April 1895	1	5	Water-tube type - New.	Nipple, used to plug a tube hole in "Header" plate.	Experimental	Do. - -	Defective fitting of the nipple	No blame attached to any person, and no order made as to costs.
862.									
"Zweena," S.S., O.N. 96,400; Messrs. Forward Bros. & Co.	14 Mar. 1895	—	—	Cylindrical multi-tubular type. 6 years.	Centre after-furnace -	Supplying steam to propelling machinery.	Board of Trade and Lloyd's.	Defective material; defects developed during manufacture and working of boiler.	Preliminary inquiry only.
863.									
(Two boilers) Bathgate; Messrs. Walker and Cameron.	19 Feb. 1895	2	1	Cylindrical egg-ended, externally fired. One probably over 32 years, and one probably over 16 years.	Shells, at circumferential seams.	Colliery purposes.	Scottish Boiler and Engine Inspection Co.	Want of proper support for boiler which first failed.	Owners were blamed slightly for insufficient precautions, and ordered to pay 42*l.* towards costs, and the Board of Trade were ordered to pay 7*l.* 7*s.* to two of the owners' employés who appeared as witnesses.
864.									
Garshuey, Londonderry; Mr. T. Motherwell.	14 May 1895	—	—	Horizontal portable - 34 years.	Furnace - - -	Working a threshing machine.	Not inspected or insured by any company or association.	Wasting from corrosion -	Owner blamed for using the boiler after being advised that it was in a dangerous state, and ordered to pay 20*l.* towards costs.

865.									
Smethwick, Birmingham; Smethwick School Board.	10 Feb. 1895	1	3	Tubular heating boiler. 7 years.	One of the tubes - -	Heating school-room.	Do. - - -	Undue pressure, consequent on imperfect circulation, the boiler not being properly filled.	The makers were blamed for not pointing out that the boiler could be properly filled only by their own patent apparatus, and were ordered to pay 30*l.* towards costs. An engineer who undertook the repair of the boiler was blamed for fitting an inefficient safety appliance, and was ordered to pay 5*l.* towards costs.
866.									
"Regalia," S.S., O.N. 67,309; Mr. J. S. Barwick.	14 May 1895	1	—	Cylindrical multi-tubular. 13 years.	Portion of the joint of a man-hole door.	Supplying steam to propelling machinery	Do. - - -	Door fitted badly, and material of joint unsuitable.	Preliminary inquiry only.
867.									
"Lavinia," S.S., O.N. 95,328; Messrs. J. Weatherill.	19 May 1895	—	—	Cylindrical multi-tubular. 5 years.	One of the rivets in man-hole compensating-ring.	Do.	Lloyd's - - -	Internal corrosion - -	Do.
868.									
"Tongariro," S.S., O.N. 76,067; New Zealand Shipping Co.	2 June 1895	—	—	Cylindrical multi-tubular. 12 years.	Tube-plate and tubes -	Do.	Board of Trade - -	Over-heating from shortness of water, due to neglect of engineers.	Do.
869.									
Twisdale Colliery, near Durham; Messrs. Bell Bros., Ltd.	5 June 1895	—	—	Cast-iron steam pipes 25 years.	Lower parts of pipes -	Conveying steam to engines.	Not inspected or insured by any company or association.	Stresses, caused by water finding its way into the pipes.	Do.
870.									
Moss Bridge, near Blackburn; Blackburn and Over Darwen Tramway Co., Ltd.	24 May 1895	—	—	Locomotive type - 5 years.	One of the tubes - -	Working a tramcar.	Scottish Boiler Insurance Co.	Thinning of tubes, owing to wasting action of grit and sulphurous fumes.	Do.

Abstract of Reports on Explosions which occurred during the 12 months ended 30th June 1895—*continued.*

No. of Report, Place of Explosion, and Owner of Boilers.	Date of Explosion.	Persons killed.	Persons injured.	General Description and Age of Boiler or Vessel which exploded.	Part of the Boiler which gave way.	Purpose for which Boiler was used.	Whether inspected or insured by any Company or Association, &c.	Cause of Explosion.	General finding of Court if a Formal Investigation held.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
871.									
New Mills, Stockport; Mr. E. Yates.	28 June 1895	—	2	Cornish type - About 27 years.	Flue - - -	Supplying steam to machinery at brass finishing works.	Scottish Boiler Insurance Co.	Undue working-pressure, and weakness from corrosion.	Preliminary inquiry only.
872.									
"Romola," S.S., O.N. 97,375; Messrs. Herskind & Co.	7 Feb. 1895	1	1	Cylindrical multitubular. 6 years.	Tube stopper blown out -	Supplying steam to propelling machinery.	Lloyd's - - -	Thread of nut stripped while stopper was being tightened.	Do.
873.									
(12 boilers) Redcar Iron Works; Messrs. Walker, Maynard & Co.	14 June 1895	12	8	Cylindrical, externally fired. Five boilers, including No. 5, 3 years old; seven boilers 20 years old.	No. 5 ripped at circumferential seam.	Supplying steam to machinery in iron works.	National Boiler and General Insurance Co.	The unequal expansion and contraction to which the boiler was subjected caused a seam rip in No. 5, and the destruction of the 11 other boilers resulted therefrom.	The owners were held responsible for the failure of their engineer to insist on the boilers being condemned after he knew they were in a dangerous condition, and were ordered to pay 200*l.* towards costs. The Boiler Insurance Co. were blamed for not pointing out the danger more explicitly, and were ordered to pay 50*l.* towards costs.
874.									
Longton; Messrs. Copestake and Procter (users).	20 May 1895	1	1	Vertical type - - 13 years.	Firebox - - -	Working a chaff cutter.	Not inspected or insured by any company or association.	Firebox worn out - -	The boiler-maker who repaired the boiler and advised the users as to working-pressure was blamed for incompetence, and ordered to pay 10*l.* towards costs.

875.								
Stainland, Halifax; Mr. J. Shaw.	23 May 1895	5	2	Cornish type - At least 31 years.	Shell - - -	Warming the mill and supplying steam to machinery.	Do. - - -	Internal and external corrosion	The owner was blamed for negligence as regards inspection, but regard was had for the heavy liabilities incurred by him through the explosion, and to the expense of defending himself against a prosecution for manslaughter arising therefrom, and he was ordered to pay only 15*l.* towards costs.
876.								
Drumgowan, Londonderry; Mr. J. Edwards.	6 April 1895	—	2	Cornish type - - About 22 years.	Shell - - -	Farm purposes	Do. - - -	External corrosion - -	The owner was blamed for negligence, and ordered to pay 12*l.* towards costs.
877.								
"Frutera," S.S., O.N. 87,931; "Frutera" S.S. Co., Ltd.	13 Mar. 1895	—	1	Cylindrical multitubular. 11 years.	Joint of man-hole door -	Supplying steam to propelling machinery.	Lloyd's - - -	Door fitted badly - -	Preliminary inquiry only.

APPENDIX B.

Classification of Causes of Explosions and Types of Boilers, 1894–95.

Causes of Explosions.	No. of Cases.
Deterioration or corrosion, or safety-valves, &c. defective, Nos. 764, 765, 766, 768, 771, 774, 776, 778, 779, 781, 784, 786, 787, 788, 789, 790, 795, 796, 797, 807, 811, 816, 817, 837, 838, 841, 844, 846, 848, 850, 851, 853, 856, 858, 860, 864, 867, 870, 871, 873, 874, 875, 876.	42
Ignorance or neglect of attendants, &c., Nos. 770, 773, 777, 783, 792, 793, 802, 810, 812, 813, 814, 815, 818, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 834, 835, 836, 839, 840, 842, 845, 847, 857, 868, 869.	36
Defective design, workmanship, material, or construction, or undue working-pressure, Nos. 767, 772, 775, 780, 782, 785, 791, 794, 798, 799, 800, 801, 803, 804, 805, 808, 819, 832, 833, 843, 849, 852, 854, 855, 859, 861, 862, 865, 866, 877.	30
Miscellaneous, Nos. 769, 806, 809, 863, 872, 873 - - - - - - -	6
Total - - - -	114

Nos. 767*, 772*, 774, 775*, 776, 777*, 779, 780, 781, 785*, 792*, 797, 798, 800*, 802*, 806*, 811, 817, 819, 822, 823*, 832*, 833, 841, 843, 846, 851, 854, 857*, 858, 862, 863*, 867, 868*, 870, 871, 872*, 873, 877 = 39 cases in which the boilers were under the inspection of Public Associations or Companies or of the Board of Trade Surveyors.

* In the cases marked with an asterisk the explosions were not due to any defect in the condition of the boiler.

Types of Boilers.

	No. of Cases.
Vertical, Nos. 768, 770, 771, 773, 777, 784, 787, 792, 793, 794, 806, 822, 853, 856, 860, 874 - - -	16
Marine, Nos. 764, 769, 774, 776, 783, 788, 789, 795, 798, 800, 801, 802, 817, 823, 841, 843, 848, 849, 850, 851, 857, 858, 861, 862, 866, 867, 868, 872, 877.	29
Heating apparatus, Nos. 805, 810, 812, 813, 814, 815, 818, 820, 821, 824, 825, 826, 827, 828, 829, 830, 831, 834, 835, 836, 837, 839, 840, 842, 845, 847, 865.	27
Land, cylindrical, Cornish, Lancashire, &c., Nos. 782, 786, 791, 796, 808, 816, 819, 859, 863, 871, 873, 875, 876	13
Locomotive, Nos. 766, 778, 779, 781, 797, 804, 811, 832, 838, 844, 846, 864, 870 - - -	13
Keirs, drying cylinders, &c., Nos. 765, 803, 852, 855 - - - - - -	4
Steam-pipes, stop-valves, receivers, superheaters, &c., Nos. 767, 772, 775, 780, 785, 799, 807, 809, 833, 854, 869	11
Miscellaneous, No. 790 - - - - - - - - -	1
	114

Vertical boilers marked V were used on board vessels, the other vertical boilers were used on land.
The marine boilers denoted by F were flue boilers, and those marked W were water tube boilers.
The land boilers denoted by the letter E were cylindrical and externally fired, and those marked C were Cornish boilers.
Steam-pipes, stop-valves, &c., denoted by the letter V were used on board vessels.

APPENDIX C.

STATISTICS FOR PAST YEARS.

TOTAL NUMBER of EXPLOSIONS dealt with since passing of the Acts, NUMBER of LIVES LOST, and NUMBER of PERSONS INJURED.

Year.	No. of Explosions.	No. of Lives Lost.	No. of Persons Injured.
1882–83	45	35	33
1883–84	41	18	62
1884–85	43	40	62
1885–86	57	33	79
1886–87	37	24	44
1887–88	61	31	52
1888–89	67	33	79
1889–90	77	21	76
1890–91	72	32	61
1891–92	88	23	82
1892–93	72	20	37
1893–94	104	24	54
1894–95	114	43	85

APPENDIX D.

REPORT by the SOLICITOR to the BOARD OF TRADE on FORMAL INVESTIGATIONS into BOILER EXPLOSIONS during the Year 1894–95.

Twenty-seven Formal Investigations were held into the circumstances attending boiler explosions which occurred during the year ending the 30th June 1895.

The investigations related to—

6	Vertical	boilers.
23	Land	„ (cylindrical, Lancashire, &c.)
3	Locomotive	„
2	Marine	„
1	Steam-pipe.	
1	Copper converter.	
1	Steam receiver.	
1	Heating apparatus.	
1	Esparto grass boiler.	

These explosions caused the death of 39 persons, and 56 persons were more or less seriously injured. Loss of life and injuries.

I have again to observe, as in previous years, that in no case has the Court attributed the explosion to an unavoidable accident, although in five cases the Court did not attach blame to anyone, and in seven cases made no order as to costs. Explosions not accidents.

The first of these cases, No. 790, related to the blowing out of a joint in the piping made with an india rubber ring, the india rubber having perished.

The second of these cases was No. 782. The Court found that the explosion was caused by overheating from shortness of water, due to the defective feeding arrangement of the boiler. It was one of a group of three; neither of them was fitted with a feed check-valve, and the internal pipe was carried to within 12½ inches from the bottom of the boiler. Under certain conditions, therefore, the water could be blown out from one boiler into another, and in the absence of a glass water-gauge, which, in the opinion of the Court, should have been fitted to each boiler, the attendant was misled

The third case, No. 791, relates to the explosion of a Cornish boiler, probably over 20 years old. The agent to the owner left the management of the boiler to a person who had worked it for 16 years. As the steam-gauge was graduated to 80 lbs., he believed that the boiler could work at that pressure, and he placed an additional weight on the safety-valve lever. In August 1894, the boiler and engine were let to the user, and this gentleman was instructed as to working the boiler by the person who had managed it for 16 years. The Court exonerated this person from blame, on the ground that he imparted to the user all the information he possessed, that he was not to blame for the unskilful manner in which it was worked at the time of the explosion, and that as the user had erred from want of skill no blame was attached to him. There was no evidence that the boiler had ever been inspected by any person.

The fourth case, No. 806, deals with the fracture of the flange of a cast-iron man-hole door in a vertical boiler used by a tramway company, caused by an unequal strain produced in screwing up the bolts. Until this explosion occurred there does not appear to have been any reason to suppose that cast-iron doors were unsafe for the purpose. The Court was clearly of opinion that cast-iron was not a suitable material for man-hole doors to boilers as the facts in this case conclusively proved.

The fifth case, No. 861, refers to a water-tube boiler which was undergoing a series of tests before being fitted on board a torpedo boat catcher. For this purpose it was necessary to remove 68 of the tubes connecting the headers, the apertures being plugged with nipples. One of these blew out, and the Court found that it had been irregularly and insufficiently expanded. This the Court held to be a faulty piece of workmanship, probably occasioned by the carelessness of a workman or by the peculiarity of his attitude when working in a confined space, which, in the circumstances, the makers of the boiler could not reasonably have discovered, and, moreover, that they had tested the boiler as plugged with these nipples by hydraulic pressure nearly 50 per cent. in excess of the steam pressure to which the boiler was subjected at the time of the explosion.

Examinations.

In nine cases explosions were due to the neglect of examination by competent persons, the boilers having been worked for periods varying from three to twenty-seven years without such examination. In one case the examination made was careless or perfunctory and defects were not discovered.

In one case the explosion was due to the screwing down of the nut on the spindle of the safety-valve balance by a man who was not the boiler attendant, and in another, the explosion was due to a defective safety-valve, the spindle passing through and extending beyond a bush.

Boiler-makers and others.

In three cases boiler repairers were found to blame, and in another the patentees of an instrument used in filling their hot-water apparatus were found to blame, for neglecting to advise clients of the necessity for using this particular instrument in filling the apparatus.

In one case the vendor (a metal broker) was found to blame for selling a boiler which he knew was defective, the owner's friend, an engineer, was found to blame for advising him to purchase it and the owner was also found to blame for neglecting to have it examined by a competent person.

Owners and users.

In eleven cases the Court found the owners or users of the boilers directly responsible for explosions, and in four cases they were held responsible for the neglect of their servants.

Colliery boilers.

Report No. 816 relates to the explosion of a boiler used to supply steam to a pumping engine at a colliery, and three children playing in the vicinity of the boiler at the time of the explosion were killed.

Under the Coal Mines Regulation Act, 1887, special rules are required to be established for "the conduct and guidance of persons acting in the management of such mine or employed in or "about the mine as under the particular state and circumstances of such mine may appear best "calculated to prevent dangerous accidents and to provide for the safety, convenience, and discipline "of the persons employed in or about the mine."

Special rules were duly established in respect of the mine in connection with which the boiler was used, and the Court observe that "although these rules provide in specific terms for the proper "examination of the safety-valves and the cleaning, firing, and feeding of the boilers, they do not "specifically provide for the examination of the boilers," and they were clearly of opinion that these special rules should state "*in no uncertain terms that the boilers are to be thoroughly inspected, at "what intervals of time they are to be inspected, and by whom this very important duty is to be "performed.*"

Verdicts of manslaughter.

Report No. 875 relates to the explosion of a boiler which was made at least 30 years ago. It had been used for supplying steam to pipes for the purpose of warming a mill, and at a later period of its history it was used to supply steam to an engine, which drove a turbine when the water power was insufficient to drive the machinery at the mill.

The boiler was never thoroughly examined by any competent person. After the explosion the plates in places were found to have been reduced from $\frac{5}{16}$ of an inch, their original thickness, to barely $\frac{1}{16}$ of an inch. No less than five persons were killed owing to this explosion, and the Coroner's jury returned a verdict of manslaughter against the owner. He was tried at the Leeds Assizes and acquitted.

Although the owner was acquitted of such culpable neglect as to render him criminally responsible, the Commissioners held that he was undoubtedly to blame for the explosion, as the boiler had not been examined by any competent person for seven years and the owner had taken no measures to ensure that it was being worked under safe conditions.

No. 874 refers to the explosion of a vertical boiler resulting in the loss of one life. The coroner's jury returned a verdict of manslaughter against one of the users. He was charged before the magistrates and the charge was dismissed. He was then tried at the Staffordshire assizes and the

judge directed the jury to acquit him. The users were carters, and they called in a person who held himself out as a boiler-maker of some 22 years' experience, and when engaged by the users he was employed by a firm as an engineer and boiler-maker.

The Commissioners, finding that the users were justified in employing this person as a boiler-maker, acquitted them of blame, but they found that the person employed was quite ignorant of the duties either of a boiler-maker or of a boiler repairer, and that he was to blame for the explosion.

Long cylindrical externally-fired boilers. Seam rips.

Report No. 873 refers to an explosion more disastrous in its effects, both in regard to loss of life, injuries to persons, and destruction of property, than any case which has hitherto formed the subject of a Formal Investigation.

Twelve boilers exploded, 12 persons were killed, and eight others were more or less seriously injured.

These boilers formed part of a group of 15 plain cylindrical externally-fired boilers, each of them about 66 ft. in length, and were constructed in the years 1872, 1875.

Seam rips occurred from time to time in the boilers, and principally on this account four patches were fitted in 1887, four in 1888, four in 1889, one in 1892, and seven in 1894. The boilers were insured by an insurance company for a sum of 500*l.* on the group, the object of the owners being to obtain regular inspections by the insurance company's inspectors, and reports as to the condition of the boilers from the insurance company.

The boilers were duly inspected by the insurance company's inspectors, and in 1888 the insurance company, referring to the prevalence of seam rips, suggested that the boilers should be cut in two in the event of changes being made.

In 1893 the insurance company again made suggestions as to cutting the boilers in two or substituting for them boilers of Lancashire type.

The insurance company contended that, although the word "danger" was not used in their reports, it would be manifest to an engineer that the presence of danger was indicated, but in the opinion of the Court the advice given by the insurance company to the owners was conveyed in indistinct terms, and that they should have used language which would have admitted of no doubt that there was real and immediate danger of explosion.

The Court found that the owners' engineer knew that the boilers were in a dangerous condition, and they found him to blame for not insisting on their condemnation.

The Court found that the explosion was due to seam rip, and they were of opinion that in the interests of public safety the use of boilers of this type of extreme length should be discontinued.

Costs and expenses.

The following amounts have been ordered to be paid towards the costs and expenses of the investigations, but these orders have not been invariably made according to the measure of blame attaching to the parties. The Court have in several instances taken the surrounding circumstances into consideration, and in making orders they have had due regard to the means of the parties, or the loss and injury suffered.

Boiler-maker	30*l.*
„ repairer	10*l.* in 2 cases, and 5*l.* in one case.
Vendor	10*l.*
Owner's friend	5*l.*
Insurance Company	50*l.*
Owners or Users	5*l.* in 1 case.
„ „	10*l.* in 5 cases.
„ „	12*l.* in 1 case.
„ „	15*l.* in 1 case.
„ „	20*l.* in 3 cases.
„ „	25*l.* in 2 cases.
„ „	40*l.* in 1 case.
„ „	42*l.* in 1 case.
„ „	65*l.* in 1 case.
„ „	90*l.* in 1 case.
„ „	200*l.* in 1 case.

Ignorance.

Many of these explosions were due to ignorance, the owners or users personally attending to them, and considering that they were safe so long as they did not leak. One owner had worked a boiler for 27 years without any examination at a pressure of 60 lbs. per square inch, and he thought that it would go on working at the same pressure for an indefinite time. Another steam user examined his boiler by tapping it with a hammer, and so long as the hammer did not go through the plates, he throught that the boiler was quite safe.

WALTER MURTON,
Solicitor, Board of Trade.

25th November 1895.

Explosives Act, 1875 (38 Vict. c. 17).

NINETEENTH ANNUAL REPORT

OF

HER MAJESTY'S INSPECTORS OF EXPLOSIVES;

BEING THEIR

Annual Report for the Year 1894.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, East Harding Street, Fleet Street, E.C.,
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1895.

[C.—7726.] *Price* 1*s.* 6*d.*

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NINETEENTH ANNUAL REPORT OF HER MAJESTY'S INSPECTORS OF EXPLOSIVES;

BEING THEIR

ANNUAL REPORT FOR THE YEAR 1894.

SIR, Home Office, 1st January 1895.

Introductory.

IN accordance with the 57th section of the Explosives Act, 1875, we, being the Government Inspectors under that Act, have the honour to furnish this the Nineteenth Annual Report of our proceedings and of the working of the Act during the year ended 31st December 1894.

Modifications of law during year.

The only modification in the previously existing law that has been made during the year is a new Order in Council, No. 15, dated 30th April 1894, prohibiting fireworks consisting of or containing sulphur in admixture with chlorate of potassium or other chlorate which experience had shown to be liable to cause accidents (*see* Appendix F.).

The modifications of the original law which have been effected since the Act of 1875 came into operation, are those embodied in Orders in Council Nos. 1(*a*), 6(*a*), 7(*a*), 7(*b*), 10(*a*), 12, 13, 14, 15, and in the Orders of Secretary of State, Nos. 3(*a*), 3(*b*), and 3 (*c*), and in the Explosives Substances Act, 1883.

We have visited every factory and magazine on our books at least once during the year, and in the case of the factories nearly one-half the number have been visited a second time. As in former years, it is with very great satisfaction that we are able to report that there has been no falling off in the high standard previously attained in the great majority of these establishments, while some of the places which had formerly lagged behind have been brought more into a line with the rest, and the condition of the factories and magazines is now generally decidedly better than it was some time ago.

Accidents.

The number of deaths from accidents by fire or explosion in manufacture was 2 only, which is largely below the average for the past 10 years, viz., 4·6. As stated in our last Annual Report, the figures show an extraordinary and most satisfactory contrast with those which obtained before the Act came into operation. We repeat that it should also be remembered that not only has the actual number of factories largely increased, but also, in many cases, the amount of output of an individual factory, and consequently the number of hands employed and the resulting chances of accident.

Moreover, the risks attending the manufacture of wholly new explosives, to which a large proportion of the new factories are applied, are less well known, and, therefore, not so easy to provide against. We have dealt with these points more fully in the "Accident" section.*

We will merely further remark here on this point that these very satisfactory results have been accomplished without any undue or even inconvenient interference with the trade.

The growth in the number of factories for explosives (viz., from 55 when the Act came into operation to 130 at the present time, and of the magazines, from 199 to 380) is in itself no small proof of this. From time to time representations have reached us that the restrictions imposed by the Act fettered competition with foreign makers, but these complaints which were freely made in anticipation of the passing of the Act in 1875, and which were more or less rife in the early days of its administration, have of late years become extremely rare, a circumstance which may probably be in part explained by the impossibility of seriously supporting the contention, and in part also by the fact that during the years which have elapsed since the English Act was passed, other countries have introduced laws and applied regulations affecting explosives, based in no small degree on our own; but, as a general rule, of greatly increased

* *See* page 27.

stringency. If proof of this were needed, we could hardly do better than point as an example to the new Belgian law relating to explosives of the 29th October last, which appears in the "Moniteur Belge" of the 8th November 1894, and this new law is in amendment of comparatively recent Acts (of 1881, 1886, and 1891) of admitted severity, which, nevertheless, say the Commissioners by whom the new regulations were recommended, proved insufficient for the public protection. Indeed, the Commissioners themselves say of the code which they submitted, "This code is exceedingly "severe, but it is rendered imperative by the exigencies of public security." Those interested in the manufacture, storage, transport, and importation of explosives in the United Kingdom may perhaps usefully occupy themselves in studying the minute and severe restrictions of this code.

So also, in Germany, many of the regulations—as, *e.g.*, that relating to the marking of cartridges, to which we have adverted elsewhere*—go far beyond the restrictions which thus far it has been deemed necessary to impose in this country.

With these preliminary observations we will pass to the detailed examination of the various points on which it falls to us to report.

I.

Manufacture.

Number of factories.

The total number of factories (under continuing certificate and license) is now 130 (exclusive of "small firework" and "toy firework" factories, which will be dealt with separately), being an increase of three on last year, when the number stood at 127.

Extinct factories.

The factories which have become extinct during the year are as follows, viz.:—

No. 51, for percussion caps. This factory has been superseded by a new factory (No. 161) on a neighbouring site.
No. 108, for fireworks.
No. 131, for cartridges or charges for cannon, blasting, &c.
No. 146, for blasting cartridges and filled shells.

New factories.

Seven new factories have been licensed. Altogether 109 factories have been licensed since the Act came into operation, viz., 102 during the 18 years from 1876 to 1893 and seven in 1894, or an average annual increase of 5·73. This increase of 109 is nearly double the number of factories existing at the passing of the Act.

Factories under continuing certificate.

The number of factories under Continuing Certificate is now 41, being one less than last year. The reduction in the number of such factories since the Act came into operation is 14, or over one-quarter of the total original number, viz., 55.

Factories under license.

The present number of factories under License is 89, or four more than the number at the end of 1893 (exclusive of "small firework" and "toy firework" factories), seven new ones having, as already stated, been licensed during the year, while three have, during the same period, ceased to exist.

Applications for factory licenses.

The number of applications for new factory licenses received during the year was six, and there were eight outstanding from the previous year.

Seven licenses were confirmed during the year, three applications were abandoned, and four still remain under consideration.

The new factories are as follows, viz.:—

Factory No. 158, for fireworks.
„ No. 159, for bellite.
„ No. 160, for miners' squibs.
„ No. 161, for percussion caps.
„ No. 162, for blasting cartridges and packing gunpowder.
„ No. 163, for dynamite No. 1.
„ No. 164, for blending gunpowder and packing explosives.

Appendix A. gives a table of all factories at present in existence, with the classes of explosives authorised to be manufactured therein; while Appendix B. specifies in detail the various natures of explosives authorised for the different factories. Appendix D (1) contains descriptions of the explosives, and Appendix E(1) gives the distribution of the factories throughout the country.

As we pointed out in our last Annual Report the growth of the trade in explosives since the passing of the Explosives Act in 1875 has been very remarkable—not only

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* *See* page 7.

has the number of factories increased from 55 to 130, but a large proportion of the factories have themselves enormously expanded, some of them having more than doubled in size. This growth of the trade may to some extent be indicated by the increase in the number of explosives which may be manufactured in the several factories, or conversely by the number of factories in which each kind of explosive can be made. As this information will, we believe, be of great interest to the manufacturers, we have reproduced and brought up to date a table showing the annual variation in respect of each nature of explosive during the 19 years since the passing of the Act. This will be found in Appendix C.

System of licensing.

We see no grounds for modifying the favourable opinion which we have frequently expressed as to the sound practical working of the system of licensing as laid down by the Act, which is calculated to ensure a thorough investigation of all technical details when the draft license is under consideration at the Home Office, while it affords ample security for the protection of the public and of the local interests concerned when the application comes before the Local Authority.

Factory amending licenses.

Fifty-five amending licenses for factories have been applied for during the year, and five were outstanding from the year before. The number of amending licenses actually confirmed during the year was 49. The number confirmed during the previous 18 years was 613. The consideration and preparation of the amending licenses often entail very heavy work on the department.

Changes in the list of licensed explosives.

The following changes have occurred in the list of licensed explosives during the year:

The following have been added to the list of authorised explosives:—

Blasting amberite.
Cordite.
Collodion cotton.
Westfalite.
Von Forster's Powder.

Collodion cotton.

As explained in our last year's report (footnote, page 5), all nitro-cotton is now admitted to be explosive. Collodion cotton therefore appears on the 'authorised' list, but the exemptions stated in last year's Annual Report, viz., when it is in solution (in alcohol and ether) or wet, or saturated with methylated spirit and enclosed in air-tight cases, will still hold good. In any one of these states it is available for conversion into collodion.

A communication was made to the manufacturers of explosives in which nitro-cotton enters, to the above effect (*see* Appendix V), and factory licenses have been applied for by some of these and are in progress.

Explosives submitted during the year.

The explosives which have been submitted during the year, with a view to their being placed on the authorised list, will be found in Dr. Dupré's Report, page 18. Explosives which have passed the tests successfully become "authorised" so soon as any license for manufacture or importation for general sale is applied for and granted. They in the meantime occupy the position of what may be called licensable explosives. Those which have passed the tests and are now licensable but not yet licensed, will be found enumerated in Appendix D (2); also the explosives which have, at one time or another, been licensed for manufacture or importation, but for which no license is at present in force, are given in Appendix D (3).

Troisdorf Smokeless Powder.

It was erroneously stated in last year's Annual Report (footnote, page 5), that the name Troisdorf Smokeless Powder had been altered to Chilworth Smokeless Powder; this was not the case, as in fact Troisdorf Smokeless Powder had disappeared from the 'authorised' list, there being no license in force for that explosive during the year, and Chilworth Smokeless Powder, with the same definition as Troisdorf Smokeless Powder, had appeared on the list. Troisdorf Smokeless Powder has now been replaced upon the list. The name of Chilworth Smokeless Powder has also been altered to Chilworth Smokeless Sporting Powder.

Alterations in definitions.

In order to make the line of demarcation between guncotton and collodion cotton clear, the definition of guncotton was altered when collodion cotton was added to the 'authorised' list; the new definition will be found in Appendix D (1). The term nitro-cotton will be substituted for nitro-cellulose in the definitions of ballistite, gelatine dynamite, blasting gelatine, &c. The definitions of carbonite and Cooppal's powder, have also been altered, as will be seen by reference to Appendix D (1).

Securite.

The manufacture of Securite, Compressed securite, and Denaby powder, has been given up during the year; these explosives have, therefore, been removed from Appendix D (1) to Appendix D (3).

Prohibition of sulphur-chlorate mixtures.

In our last year's Report we explained the course which we had adopted to prevent the continued use of firework compositions containing chlorates and sulphur, which we showed had given rise to an extremely large proportion of accidents.*

We set forth the steps which we had taken to obtain the views of the trade as to the practicability of entirely prohibiting the manufacture and use of such admixtures.

As a result of our recommendation to the Secretary of State an Order in Council (No. 15) was made on 30th April 1894, (Appendix F,) by which the manufacture of compositions containing sulphur and chlorate was prohibited, except with the authority of and on conditions approved by a Government Inspector, as from the 1st June last, and the keeping, &c. of fireworks containing this composition was prohibited (subject to the same special authority by a Government Inspector) as from the end of the year 1894. (For Circular letter of the 16th May to Firework Makers, *see* Appendix V (1)). We have seen no reason to doubt the soundness of the view which we took. The large majority of the trade, including some who originally were indisposed to favour total prohibition, have expressed their entire approval of the steps which have been taken; and, although in a few instances manufacturers complain that they are put to personal loss and inconvenience by the prohibition, and are unable to satisfy the requirements of their trade, we cannot doubt that they will before long find, like the majority of their competitors, a solution of the difficulty. At any rate, the Order is one which it will be our duty to inflexibly enforce all round, for what one can do, another can do, in the way of dispensing with the use of a dangerous composition; and, indeed, if the view of the opponents of the prohibition, that the enforced disuse of chlorate-sulphur mixtures impairs in some degree the efficiency of their pyrotechnic productions, that consideration would furnish an argument not for, but in opposition to, granting special relief to individual manufacturers.

In one instance only, and then only for a period of six months with a view to the prosecution of experiments, has any relieving authority been given. And in this case (Messrs. Jennison & Co., Bellevue Gardens, Manchester) the authority extended only to fireworks for use and immediate consumption in the Bellevue Gardens.

"Jelly-bag" system of mixing cap composition.

We have elsewhere† adverted to the fact that, in consequence of the accident (No. 105 of 1893) which occurred in mixing cap composition by hand at the ammunition works of Messrs. Joyce and Co., Limited, on the 22nd December, 1893,‡ a circular letter, a copy of which will be found in Appendix S, was addressed to the manufacturers on the 8th of March, asking them whether, in view of the above accident, they would be prepared to take steps to substitute the jelly-bag system (of the value and efficiency of which experience has been obtained), or some not less efficient arrangement for the process of hand-mixing. The replies generally were entirely in favour of the adoption of this system where it was not already in force, and to the effect that steps would be taken to substitute it for the old process. A provision making the use of the jelly-bag system compulsory is introduced into all new licenses granted, and practically this system may now be said to be universally in vogue.

When a cap ceases to be a "percussion cap" and becomes a "detonator."

We may also advert to the particulars, which are given in the experiment section, of some experiments carried out by us to determine the circumstances and conditions under which a cap ceases to be a "percussion cap" and becomes a "detonator,"§ and to the conclusion which we arrived at (and which is embodied in our circular letter to the Trade, *see* Appendix V (3)), viz., that a "percussion cap" is one containing a charge not exceeding ·5 grains of composition, or ·6 grains of composition, where the quantity of fulminate of mercury does not exceed one quarter of such composition; in any other case the cap will rank as a detonator.

Quick-firing ammunition. Removal of some of the restrictions affecting the same.

Quick-firing ammunition, which was previously licensed for manufacture only for direct issue to Her Majesty's land and sea forces, was allowed, in 1891, to be made for export, by water transport only, in the case of one factory situated on the banks of the Thames,‖ as such direct water transmission obviates the possible dangers of the conveyance of this ammunition under ordinary conditions of transport by land which had hitherto barred its general manufacture.

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* Annual Report for 1893, pp. 33, 34. † *See* page 35. ‡ *See* Annual Report for 1893, page 32.

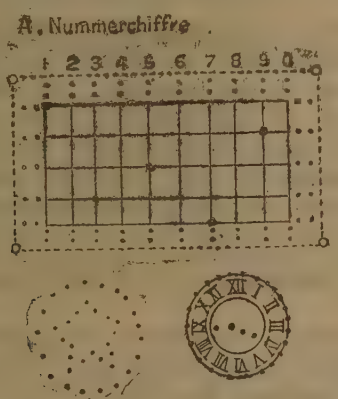
§ By Order in Council No. 1, "A 'Detonator' means a capsule or case which is of such strength and "construction, and contains an explosive of the fulminate explosive class in such quantity, that the explosion "of one capsule or case will communicate the explosion to other like capsules or cases."

‖ Factory No. 138 (*see* Annual Report for 1891, page 5).

The manufacture of this ammunition was further extended in 1892, permission having been given in the case of one factory,* and again in the case of one factory in 1893, to make it for private sale, subject to the condition that it is packed for conveyance in special packages approved as being in accordance with the arrangements for diminishing the risk from concussion, suggested in the memorandum issued on the 14th November 1888.† Power is reserved to determine the use of such packages if it shall appear at any time that they do not afford reasonable security against this risk or are otherwise open to objection. This permission was extended to another factory‡ during the past year subject to the same conditions.

Identification of cartridges made with high explosives.

The German Government have recently introduced regulations for ensuring the identification of individual cartridges by applying to each cartridge a mark indicating the factory of origin, the date of manufacture, and the number of case in which the cartridge was originally packed. The system is an extremely ingenious one, each factory having a particular private mark assigned to it, while the year is marked by an arrangement similar to the face and hands of a clock; for example, the marks representing the hands in the case of the year 1894 would stand respectively at 9 and 4, or what would correspond to 9 and 4 on a clock. The numbering of the cartridges to correspond with the case is effected by means of a parallelogram bearing 10 numbers (1 to 0), and there are five horizontal lines cutting the vertical lines which correspond with the numerals; and the number of the case would be shown by marks at the junction of the horizontal lines with the vertical lines headed respectively by one of the numerals; thus, supposing a case to bear the number 19,537, the marks would be made at the points where the five horizontal lines cut the vertical lines numbered respectively 1, 9, 5, 3, 7:—



Assuming the desirability of some secrecy in regard to the marks, the arrangements whereby the identification is effected in cipher is doubtless very ingenious, and we understand that the German Government attach some importance to the marks of identification being kept secret, especially in the case of thefts of cartridges. But apart from this consideration the arrangements would seem to be somewhat unnecessarily elaborate, though the object accomplished, viz., the identification of individual cartridges, is undoubtedly useful and advantageous.

In Belgium, also, regulations have been adopted prohibiting the issue of any cartridges not marked and numbered.

We thought it desirable to put this matter before the English manufacturers, and invite an expression of their opinion thereon, and we issued a circular letter on 9th August with this view to the principal makers of high explosives (*see* Appendix V (2)).

We have been favoured with a number of very valuable opinions in reply, and these opinions have received our most careful consideration. The result, as embodied in a further circular letter, dated 17th December, is that we have decided that in view of the expense and inconvenience which it has been shown to us the system would entail, in view also, of the steps already voluntarily adopted by some manufacturers for identifying, at any rate, *the packages* issued by them, and of the facility with which the elaborate and costly precautions could apparently be defeated

* Factory No. 47. † *See* Annual Report for 1888, pp. 5, 69. ‡ Factory No. 46.

by evil disposed persons, the necessity for effecting the compulsory adoption of a system of individual cartridge identification has not yet been adequately made out, and that any further steps in that direction may therefore be reasonably allowed to stand over for the present, but without prejudice to the revival of the subject should the occasion or necessity hereafter appear. Meanwhile, we have, by the circular letter of the 17th December above referred to, pressed upon the manufacturers the desirability of keeping the matter in view, and in any case of properly identifying all packages containing explosive not only with the factory of origin, but with a particular date or period of manufacture.

Memorandum for inventors.

For the assistance of inventors who desire to have explosives examined with a view to their being placed on the list of authorised explosives, a memorandum which was prepared some time ago, giving the necessary information as to the steps to be taken by them, and which has appeared in previous Annual Reports, is reprinted in Appendix R.

Visits to factories.

During the year we have paid 192 visits to the factories, which now number 130, all of them having been visited once and about half of them a second time.

There has been no falling off in the general improvement referred to in our previous reports in the factories. The high standard of excellence which has been gradually reached since the passing of the Explosives Act has, as a rule, been fully maintained. We believe that, taken as a whole, the factories for explosives in the United Kingdom will compare extremely favourably with any other factories, whether in the Kingdom or abroad.

Our relations, too, with both employers and employed generally continue, we are glad to say, to be on the same satisfactory footing as they have now been for several years past.

Proceedings for irregularities in the factories are now, happily, of rare occurrence. It is perhaps unavoidable that we should find breaches of the Act in the course of our visits to some of the factories, but they are usually of a minor character, and, as a rule, are at once rectified when attention is drawn to them. In a few instances, however, such irregularities, although separately of a minor character, have been more numerous than could be reasonably passed over, and we have had to take strong measures, by energetic remonstrance and otherwise, to prevent a repetition of such infraction of the law.

Proceedings taken in case of factories.

In one case only was the institution of proceedings actually necessary. This was as follows:—

Mr. B. T. Moore, the occupier of a factory at Crayfordness, was prosecuted for employing a boy under 16 not under supervision. He was fined 5*l.* and 19*s.* costs. (The prosecution arose out of accident No. 18 of 1894.)

The particulars of the offence in the above case will be found in Appendix T (*a*).

In another case (viz., at the Gunpowder Factory of the East Cornwall Powder Company at Herodsfoot) proceedings were foregone on the occupiers themselves taking proceedings against the offending workman, a fine of 10*s.* being inflicted by the Court.

Proceedings were instituted by Messrs. C. T. Brock and Co., under Section 87 of the Act, against two of their workpeople at their Haroldwood factory, who were found at one of our inspections wearing clothing with pockets in a danger building. Fines of 12*s.* 6*d.* were inflicted, including costs.

Seizures in factories.

In addition to the above, we found it necessary to place explosive under seizure at five factories as follows:—

At the factory of the Cotton Powder Company, Limited, at Faversham, 90 lbs. of tonite No. 3, subsequently released; at the factory of the Lowwood Gunpowder Company at Lowwood, 420 lbs. of gunpowder, released on the offending workman being fined by the Company; at the factory of Messrs. T. and G. Baker at Walthamstow, 650 lbs. of manufactured fireworks, released on the proprietors taking out an amending license; at the factory of Messrs. Jas. Pain and Sons, at Mitcham, 234 lbs. of manufactured fireworks and stars, subsequently released; and at the factory of Mr. J. Hodsman, at Dublin, 27 lbs. of gunpowder, which was destroyed.

Unlawful entry.

One instance of the unlawful entry of a factory magazine has been brought to our notice during the year, some boys having in July broken into one of the factory magazines at the factory of Messrs. Ludlow and Co., at Greet, near Birmingham, and stolen some gunpowder. Whilst playing with it an explosion occurred. (*See* Accident No. 74 in Appendix W.)

It has not been found necessary to give any notice under sections 24 and 56 of th Act to require a reduction of the amount of explosive present in a building.

Accidents in factories.

During the year there have come under our notice 33 accidents in manufacture, causing two deaths, and injuring 10 persons. They are fully dealt with in the Accident section of this Report, and in Appendix W.

Toy firework factories.

No licenses for toy firework factories (*i.e.*, for the making of bon-bon crackers, throwdowns, and amorces) have been granted during the year. The number of such factories at present in existence is 11 (*see* Appendix B). All these factories, except one, near Manchester, are in the metropolitan district.

Small firework factories.

We have obtained no fresh returns of small firework factories from the Local Authorities since 1892, when the number licensed was 19 only (all of which are in England), as compared with 24 in 1885, and 29 in 1880; we propose obtaining fresh returns this year. As we stated in former Reports, this is a very marked falling off, but, on the other hand, three new factories had been licensed in the place of them during 1891 and 1892. The limited scale of manufacture allowed in a small firework factory does not generally admit of the production of more fireworks than is sufficient for small displays, and the squibs, crackers, &c. sold about the 5th November, and known as "shop goods," from the manufacture of which very little profit is derived. The occupiers of these factories, therefore, find a license for a factory proper, where they can carry on work on a much larger scale, more to their interest.

The distribution in counties of the small firework factories now on our books is shown in Appendix E(2). Four of these are in the London district, two in the neighbourhood of Birmingham, and two near Bristol, the remainder being scattered over the country.

We have visited four of these during the year, and found that the improved condition noticed in recent years has been maintained.

We have not had occasion to take proceedings against the occupiers of any small firework factories, either ourselves or through the local authority.

Illegal manufacture.

It is satisfactory to be able to state that only one instance of illegal manufacture has come under our notice during the year. This was a case in which an accident (89) occurred in the house of a miner, at Spennymoor, Durham. The man admitted that he had been making blasting cartridges the day previous to the accident. Proceedings were instituted against him by the local authority, and he was convicted and fined.

II.

Storage.

Number of magazines.

Magazines.—The total number of magazines (under Continuing Certificate and License) is now 380,* being a decrease of one on last year, when the number stood at 381.

The decrease of one has been caused by five being struck off our books, while four only have been added during the year. The total number of new magazines licensed since the Act came into operation is 283.

Magazines under Continuing Certificate.

As regards magazines under Continuing Certificate, the number now in existence is 139, or three less than last year. Magazines No. 12 (Carnarvon), No. 42 (York), and 169 (Stafford) have been struck off our books during the year. There has been a reduction of 60 out of the 199 magazines for which Continuing Certificates were obtained when the Act came into operation.

Magazines under License.

As regards magazines under License, the number now in existence (including the three Mersey magazines, which have been subject to our inspection from the 15th January 1884) is 241, being an increase of two on last year. During the year two have ceased to exist, viz., No. 331 (Merioneth), and No. 477 (Renfrew), and four new magazines have been licensed.

* The number actually in use is 377, Nos. 69, 170, and 178, having given notice, under section 13, of temporary disuse. In addition, there exists on our books a magazine in Erith Marshes (No. 200), established by this Department in conjunction with the Metropolitan and City Police for the deposit of seized explosives. This magazine is, however, exempt from the operation of the Act under section 97, and is not included by us in our list of magazines.

All of the new licenses have been granted on the principle adopted on the 1st January 1891, and referred to in our Annual Report for 1890, page 8; that is to say, they are licensed to contain any "authorised" explosive of Classes 1 to 4. In some cases detonators and electric detonator fuzes are also allowed to be stored in an annexe erected for the purpose.

We have found that the new system is very satisfactory to the trade, and it saves the expense and trouble formerly incurred when the occupier of a magazine wished to store a new explosive, or even when the definition of an explosive was, however slightly, altered.

In Appendix E (1) will be found the distribution of the 380 magazines throughout the country.

Applications for magazine licenses. The number of applications for magazine licenses during the year was three, and there were 10 outstanding from the previous year. Of these, five were withdrawn or abandoned, and four were confirmed. Four are still in progress.

Magazine amending licenses. Seventeen magazine amending licenses have been applied for during the year, and there were six outstanding from the previous year. Of these 23 applications, two were withdrawn, 16 received confirmation, and five are in progress. Owing to a large number of the magazines being now licensed for all authorised explosives of Classes 1 to 4, the necessity for amendment of the license whenever a new explosive is to be stored no longer exists.

Storage of quick-firing ammunition. During the month of December we received applications from the occupiers of some magazines* licensed for the storage of explosives of Classes 1 to 4, for permission to store quick-firing ammunition, and amending licenses will accordingly be granted on condition that the ammunition is of such a design as may, from time to time, be approved by a Government Inspector for manufacture at a licensed factory, and provided (1) that all such quick-firing ammunition be kept in packages of a pattern for the time being authorised by a Government Inspector for the packing for conveyance from the factory of origin of quick-firing ammunition for private sale; and (2) that each package (in addition to being otherwise marked as the Act requires) be legibly marked or labelled with the name of the factory of origin; and (3) that all such quick-firing ammunition kept in the magazine be intended for issue only for export or for private sale (not being general sale) and be issued only for such purposes; further that when any quick-firing ammunition is kept in the magazine, no other explosive shall be present therein.

Protection of floating magazines from fire. In consequence of the narrow escape from an explosion on board the "Loch Sloy" referred to in the Accident Section of last year's Report,† the circular which we addressed to the occupiers of floating magazines in which a fire is allowed, suggesting that the woodwork in the immediate vicinity of such fire should be protected with two sheets of iron or steel (preferentially with a small air space), or with one sheet of iron or steel and a layer of asbestos, has resulted in replies being received from the occupiers showing that in the majority of cases steps have been taken to meet the wishes of the Department.

Magazine struck by lightning. During the year one magazine (No. 359), at Sancreed, Cornwall, was struck by lightning. The conductor effectually saved the building from damage, but the ground was torn up in the neighbourhood of the earth plate. This would tend to show that the resistance to earth was too high. It is very advisable that occupiers of magazines should have this resistance, as well as that of the conductor itself, tested from time to time by a competent electrician.

Visits to magazines. During the year we have paid 419 visits of inspection to the 380 magazines in the United Kingdom. All have been inspected once, and, as the numbers show, a small proportion of them more than once. We are pleased to be able to report that there has been no falling off in the standard of excellence which the great majority have attained since the passing of the Act; and in many instances the advance has been appreciable.

Unlawful entry. No instance of unlawful entry of magazines has been brought under our notice during the year.

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* Magazines Nos. 468 and 472.

† Annual Report for 1893, p. 35.

We have found it necessary during the year to institute proceedings in respect of irregularities in two magazines, viz. :— Proceedings taken in the case of magazines

The Lancashire Explosives Company, Limited, were prosecuted for four irregularities in connexion with their Magazine, No. 475 (York), and fined 4*l.* 1*s.* and 4*l.* 2*s.* costs. (*See* Appendix T (*a*)).

Mr. John Percy Smith was prosecuted for four irregularities in connexion with his Magazine, No. 132 (Durham) and fined 12*l.* and 3*l.* 10*s.* costs. (*See* Appendix T(*a*)).

In two cases, also, we placed explosive under seizure for an irregularity in the magazine, viz., at Magazine No. 444, in the occupation of Messrs. Hunter and Walker, at Cambuslang, and at Magazine No. 197, in the occupation of the Manchester Ship Canal Company, at Ince. In the first case, detonators were kept in contravention of the terms of the License, and in the other case, gunpowder was kept in contravention of the terms of the Continuing Certificate. The explosives were subsequently released without further action being taken, after the irregularities had been remedied.

There has been no accident by fire or explosion in any magazine during the year.

In an extinct magazine (No. 21) at Plas Brereton, Carnarvon, we found some 50 lbs. of gunpowder. It was placed under seizure. The explanation as to the illegal storage proved reasonable, and the powder was released on the owner paying the expenses incurred by the police in removing it to a licensed place of storage.

Stores.—We have not obtained fresh returns of stores from the Local Authorities since 1892, when the number was 2,188, of which 1,698 were in England and Wales, 417 in Scotland, and 73 in Ireland. We propose obtaining fresh returns this year. Stores.

The detailed distribution of these stores is shown in Appendix E(2). We have continued the practice of devoting as much time as we could spare from other duties to inspecting a certain number of stores as samples in such districts as we have been able to visit during the year, and thus obtaining some measure of the degree of efficiency with which the Act is worked within such districts. We have in this way succeeded in visiting 84 during the year.

As before, the condition of the stores still continues to advance, and great progress has been made in the way of rendering them more secure, particularly in certain districts. The outer doors of the stores in some counties are now very generally protected by iron plating. Great improvement is also visible in the construction of new stores, which we have recommended should be built on the general lines laid down for the construction of new magazines. We are glad to notice that the Chief Constables of counties have, as a rule, taken strong action in this direction, in consequence of the recommendations made to them by us in 1885.

One case of unlawful entry of a store has been brought to our notice during the year. It occurred at Store No. 1,818, at Bryncethin Slate Quarry, in the occupation of the Bryncethin Slate Quarry Company, when 4 lbs. of dynamite, 1 lb. of powder, and 16 yards of safety fuze were stolen. The theft was traced to a man who committed an outrage in the neighbourhood, for which he was convicted and sentenced to seven years' penal servitude. (*See* Appendix P.) Unlawful entry of stores.

It is gratifying to be able to state that in only one instance were we compelled either to place explosive under seizure in a store, or to institute proceedings against the occupier; and in this instance a prosecution was undertaken at our instigation by the Local Authority. In this case 15 lbs. of gelignite were seized in a store (No. 1354) at Blaydon, Newcastle, Northumberland, in the occupation of the Stella Coal Company. The manager of the company was prosecuted, but the case was dismissed with costs. (*See* Appendices T(*b*) and U.) Proceedings and seizures in case of stores.

There has been no accident by explosion or fire in any store during the year.

Registered Premises.—As in the case of stores, we have not obtained fresh returns of registered premises from the Local Authorities since 1892, when the number was 27,966, of which 24,846 were in England and Wales, 2,287 in Scotland, and 833 in Ireland; we propose obtaining fresh returns this year. Registered premises.

A small proportion of these registered premises will be found in mines, quarries, and collieries, where the quantity of explosive used is insufficient to require a store license.

The detailed distribution of these registered premises is shown in Appendix E(2).

Proceedings and seizures in case of registered premises.

During the year we have visited 202 registered premises, chiefly in boroughs and towns. In 11 cases we were compelled to place explosives under seizure, and in nine instances the occupiers were prosecuted by the Local Authority at our instigation. (*See* Appendices T(*b*) and U.)

Illegal storage.

As usual, some cases of illegal storage have come under our notice. These will be found in Appendix T(*b*), convictions having been obtained as follows:—

Mr. Stuart, of Pitlochry, was prosecuted at our instigation, and fined 5*s.* and 19*s.* costs, for keeping 100 lbs. of gunpowder on unregistered premises. (*See* Appendix T(*b*).)

Mark Appleby, of Embleton, was prosecuted by the Local Authority for keeping carbonite in an unauthorised place, and fined 1*l.* and 12*s.* costs. (*See* Appendix T(*b*).)

John Denholm, of Larbert, Stirlingshire, was fined 25*l.* for keeping for sale, in an unauthorised place, 2,487½ lbs. of explosives. (*See* Appendix T(*b*).)

Isaac Biber, of Ystradyfodwg, Glamorgan, was fined 20*s.* for keeping explosives without a Police Certificate.

Doubtless there have been many other cases of illegal storage, and convictions for the same, which have not come under our notice.

Breaking bulk.

As in 1893, we continue to find occasionally instances of "breaking bulk" on registered premises of quantities of explosive exceeding 1 lb. To this point we always draw the special attention of the occupiers and of the local officers, as it is a fruitful source of danger. It is always to be borne in mind that the explosion of any considerable amount of explosive upon registered premises is likely, as a rule, to be more disastrous than in a properly isolated magazine or store. If 100 lbs. of powder explodes in a house or shop in the middle of a town, the personal and structural injuries are likely to be far more serious than if a much larger amount exploded in an isolated building.

The officer of the Local Authority has, in all cases where it was practicable, accompanied us on our visits to the registered premises.

Accidents in registered premises.

There have been three accidents in registered premises during the year, one of them having occurred in a filling room for the manufacture of small-arm cartridges, under section 46. One had fatal results. These accidents are dealt with in the "Accident" Section of this Report.*

III.

Packing and Conveyance of Explosives.

Packing of explosives.

We have had no reason to find fault with the character of the packages generally in use for the various explosives. As a rule they fulfil their purposes excellently.

Special authorities for packing explosives.

During the year 17 special authorities have been given for a departure from the method of packing explosives directed by the Explosives Act and Orders of the Secretary of State made under that Act. This exceeds the number given in any year since 1886. The majority of these special authorities were given for consignments of guncotton, mostly for torpedoes either in this country or for export. The remainder are of a miscellaneous character, and include two for paste for cordite when conveyed from one factory to another for conversion into cordite.

We have made it a practice to grant these authorities only in order to meet some exceptional conditions or requirement, and have repeatedly refused applications to make them of a more general character.

We are distinctly of opinion that where a permanent alteration of the law with regard to packing is necessary, it should take the form of an Order of Secretary of State, and not of a Special Authority by Her Majesty's Inspectors, such authorities being only designed, in our judgment, to meet exceptional or emergent cases.

Case of illegal packing.

Henry Jones, of 302, Holloway Road, N., was prosecuted for not properly marking a case of fireworks (viz., capillary tubes containing sulphuric acid inclosed in packets of a mixture of chlorate, realgar and sugar), which he left for conveyance at a railway

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* *See* p. 36.

receiving office. The illegality was disclosed by an explosion of the articles. A fine of 10*l.* and 2*s.* costs was inflicted. (*See* Appendix T(*a*).)

As stated under the head of Scares, Hoaxes, and False Alarms,* with a view to obtaining a prize offered by a certain weekly periodical, two residents of Tamworth despatched 24 bogus bombs, containing copies of the periodical referred to, to different parts of the United Kingdom. These were fitted with percussion caps, intended to be fired on the opening of the boxes in which they were contained, and were sent by rail without their being marked as required by the Act, and without the statutory notice to the railway companies concerned. Proceedings were instituted against them for these breaches of the Railway Byelaws, and they were convicted, each being fined 48*l.* The particulars of the charges will be seen in Appendix T(*a*).

Conveyance by road.

The conveyance of explosives by road is now, *so far as we have observed*, generally conducted in accordance with the requirements of the law.

But, as we have remarked in former Reports, this is a point which we have, for obvious reasons, very little opportunity of personally observing, and is one for which the Local Authorities must be practically considered as solely responsible. It is of course possible that many offences against the provisions of the Act in this respect are committed and not detected, but we have reason to believe that, owing to the increased vigilance of the Local Authorities, at all events in districts where explosives are largely conveyed, the chances of detection are considerably greater than formerly.

Wreck of S.S. "Ossian" with cargo of dymamite, &c.

During the severe gale which prevailed on the 22nd December, the steamship "Ossian," belonging to Nobel's Explosives Company, Limited, and having on board a cargo of 20,000 lbs. of dynamite No. 1, and 10,500 lbs. of blasting gelatine No. 1, was driven by a gale from her anchorage in Lamlash Bay on to Holy Island, where she went ashore and was washed high and dry on to the rocks. She became a total wreck, and the cargo was scattered about the rocks and in the water. Nobel's Explosives Company at once despatched workmen to the scene of the disaster to collect such of the dynamite, &c. as could be obtained, and to adopt such steps as might be necessary for averting the risk which the presence of a quantity of explosives would entail. At the date† of this report, the salvage of the cargo was not completed, and we are, therefore, unable at present to give full details as to the course of action in the matter.

There have been several other cases of vessels containing nitro-glycerine preparations, being sunk or wrecked, as notably the case of the "Drumhendry," in the Mersey, in February 1891, and the sinking of two floating magazines at Holehaven in 1881 and 1885.‡ Owing to the difficulty in recovering the whole of the explosive, especially when a large proportion of it consists of exuded nitro-glycerine, these occurrences are always of a character to justify serious anxiety and alarm; and the fact that in the case of the vessel "Essequibo," at Larne, no less than nine years elapsed from the time of the vessel being wrecked to the time when an explosion, by which two men lost their lives occurred, from the unsuspected presence of some remaining nitro-glycerine, shows that no reasonable limit can be placed to the time during which such risk may continue. It is, therefore, of the first necessity that thoroughly effective measures should in all such cases be taken to remove, as far as possible, by destruction or otherwise, all traces of explosive; a task, however, which involves, it must be admitted, very grave, and, in some cases, almost insuperable difficulties.

Conveyance in vans driven by electricity.

In the month of October a proposition to convey gunpowder in vans driven by electricity came before the Department and was referred to the Electrical Adviser. He pointed out that there would always be some risk of powder dust coming in contact with the sparks at the commutator of the motor, and that there would also be the additional risk of an explosion of the gas given off by the accumulator cells when submitted to jolting.

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* *See* p. 60.

† Whilst this Report was in progress, one of Her Majesty's Inspectors visited the scene of the wreck and inquired into the steps which were being taken to get rid of the explosives. It was found that the vessel itself had been almost entirely cleared of nitro-glycerine, but that there was still a considerable quantity of explosive strewed along the beach, though much had already been collected and destroyed. Two men were engaged in the work, and instructions were given to them to continue the search systematically. When this has been done the Company propose to put up notices warning persons from approaching the vessel or the portion of the beach on which it lies.

‡ *See* Annual Report for 1881, page 10 (Magazine "O.P.Q."), and for 1885, page 14 (Magazine "George and Valentine.")

No doubt these risks could be minimized by careful construction; but it is doubtful whether the advantages of electric traction would be sufficient to render it desirable to increase the risk of explosion even in the smallest degree.

Conveyance by sea.

The Board of Trade issued a circular letter on 3rd August to their Principal Marine Officers, notifying that safety cartridges, percussion caps, railway fog signals, and safety fuze for blasting might be carried on board passenger vessels in future, provided they were packed in accordance with the requirements of the Order of the Secretary of State.

Cases of illegal conveyance.

No case of illegal conveyance of explosives has come under our notice during the year.

Carriage by railway.

In respect of railways (and docks worked by railway companies) the 1876 code of byelaws remains unaltered.

There are now 127 railways (and docks worked by railway companies) under this code, byelaws for eight more railways having been sanctioned during the year.

The number of railways and docks worked by railway companies on which explosives are prohibited remains at 17.

For details as to the railways, &c. carrying and not carrying explosives, *see* Appendix G.

Canals.

The code of byelaws for canals, which was approved by the Board of Trade in 1876, and quoted in our Annual Report for that year, is still in force, and we have seen no reason for suggesting any alteration in the same.

The number of canals working under these regulations remains at 109, none having been added during the year.

The number of canals which have given notice that they do not carry explosives remains at 11, as since 1876. For details as to canals carrying and not carrying explosives, *see* Appendix H.

Harbours and docks.

At the date of our last Report, 276 harbours and docks were provided for.

Of this number, 47 had no trade in explosives, or had prohibited under former Acts and 70 had prohibited under the Explosives Act, 1875.

General byelaws regulating the traffic in explosives have been sanctioned by the Board of Trade for Lamlash Bay and Preston, and additional byelaws for the Mersey have also been sanctioned during the year.

There are, therefore, now 138 harbours and docks where a general traffic is provided for; and in 23 cases a limited traffic is provided for. The number of harbours and docks where no traffic in explosives exists is 47; that of the harbours and docks in which such traffic is absolutely prohibited under the Explosives Act, 1875, is 70. Thus a total of 278 harbours and docks is provided for in one way or another. This number comprehends nearly the whole of the harbours of importance. For details, *see* Appendix I.

The following table shows in a synoptical form the condition of the railways, canals, harbours, and docks, in regard to the making of byelaws:—

—	Number of Companies, Harbours, and Docks which have made Byelaws regulating the Traffic in Explosives (including those which allow of a limited Traffic).			Number of Companies, Harbours, and Docks which have notified that they either will not admit a Traffic in Explosives or have no such Traffic.		
	Railways.	Canals.	Harbours and Docks.	Railways.	Canals.	Harbours and Docks.
England - - - -	78	97	86	16	9	36
Scotland - - - -	19	3	26	—	1	63
Ireland - - - -	30	9	49	1	1	18
Total - -	127	109	161	17	11	117

As we have remarked in previous Reports, these figures appear to us to afford a perfectly satisfactory answer to the anticipations which were expressed by some of the trade when the Act first came into operation, that the effect of the restrictive regulations would be to deter the railways and canals generally from carrying explosives, and to close the harbours against this class of goods.

One accident occurred during the year in the conveyance of explosives. (*See* Accident No. 1, page 37, and Appendix W.) Accidents in conveyance.

IV.

Importation.

In accordance with the regulation referred to at page 13 of our Report for 1890, importation licenses are now valid for one importation only, and more recently it has been decided that the duration of all such licenses shall be limited to six months. The importation of the consignment for which the license was obtained must therefore be effected within that period.

The number of licenses granted during 1894 was 93, as compared with 88 granted in 1893 and 150 in 1892.

The amount of foreign nitro-glycerine compounds suitable for blasting purposes imported during the year was as follows:— Nitro-glycerine compounds.

	Lbs.
Dynamite	23,000
Gelatine dynamite	279,500
Matagnite gelatine	35,302
Carbonite	202,000½
	539,802½

This is less than the amount (576,950 lbs.) imported in 1893, and is a very large decrease on 1892, in which the total of these compounds imported amounted to 850,000 lbs. It is a still larger decrease on the average of previous years.

Dynamite has again fallen from 24,200 lbs. to 23,000 lbs., and gelatine dynamite from 400,050 lbs. to 279,800 lbs., or about 30 per cent. On the other hand, matagnite gelatine has increased from 16,350 lbs. to 35,202 lbs., or more than doubled, and carbonite also shows a very large increase.

It may be interesting to place on record the amounts of nitro-glycerine explosives imported for blasting purposes during the previous ten years, which were as follows:—

Year.	Lbs.	Year.	Lbs.
1884	1,085,000	1889	1,325,950
1885	1,068,100	1890	899,652
1886	1,073,500	1891	734,100
1887	707,500	1892	856,668
1888	1,120,800	1893	576,950

The very large number of detonators imported during the year (viz., 9,765,400) is in excess of the number imported in 1893 (viz., 7,179,000), and shows that a great percentage of this trade remains, as hitherto, in foreign hands. It will be seen, however, from Appendix B., that there are six factories in this country in which these indispensable adjuncts to the use of high explosives can be made. Detonators.

More than 580,000 lbs. (or 290 "tons") of fireworks were imported against 190 "tons" last year. They were chiefly of the kind known as Oriental fireworks from China and Japan, and it is a matter for surprise that there could have been a demand for such a very large number of these articles. Fireworks.

The amount of toy fireworks imported was insignificant, the bulk of those sold being now manufactured in this country.

The details of all the importations made during the year will be found in Appendix J. With the above exceptions they call for no special remarks. Appendix K shows the number of licenses granted for each nature of explosive during the year.

As explained in previous Reports, a considerable amount of imported explosive is not really for home consumption, but is simply brought into this country for re-shipment abroad. Such a transaction has to be covered by an importation license, but we have not thought it necessary to attempt to ascertain exactly what proportion is so re-exported, and what proportion finds its way into the English

market. Every cargo brought into English waters is sampled and examined and otherwise treated exactly as if it were for home consumption, and we take no note of its actual destination.*

Irregularities in the importation of explosives. Amorces.

The following cases of illegal importations took place during the year :—

In February Messrs. Lamport and Holt imported three cases of amorces into the Mersey without a license. The goods were destroyed and the firm prosecuted and fined. (*See* Appendix T(*b*).)

In June the Cunard Steamship Company, Limited, committed a breach of the law by importing amorces into Liverpool (ex "British Queen") without a license. They were prosecuted by the dock authorities and fined.

Mikado balloons.

In November a case of samples of Mikado balloons and crack shots was imported by Messrs. Barr, Moering, & Co. without a license. The matter was left to the Customs to deal with as they thought fit, except that the goods were not to be admitted until an importation license had been taken out.

Cartridges.

In January the Customs reported the importation of a case of cartridges with explosive bullets, for which no license was produced. On examination the bullets were found to contain no explosive matter, and the cartridges were therefore safety cartridges, requiring no license.

Safety cartridges.

In July the Maxim-Nordenfelt Guns and Ammunition Company, Limited, were the consignees of a case of safety cartridges seized by the Customs on account of improper marking. But as the goods were correctly described in the bill of lading it was decided to overlook the offence.

Carbonite.

Mr. Richter, of Newcastle, imported, under License No. 485*a*, some carbonite which contained a slight excess of nitro-glycerine over that allowed by the license. The attention of the manufacturers was drawn to this excess. A subsequent consignment, under License No. 503*a*, also contained a slight excess, and the agents were again and very emphatically cautioned against a repetition of this breach of the terms of the license.

Defective matagnite gelatine.

Exudation of nitro-glycerine from matagnite gelatine was noticed in two consignments imported by Mr. Watson, but it was not sufficiently marked to warrant the condemnation of the explosive.

B.N. Powder.

The explosive imported under License No. 504*a* for B. N. powder, granted to the Maxim-Nordenfelt Guns and Ammunition Company, Limited, proved on examination to differ materially in composition from that allowed by the license. The Company explained that the explosive imported was what is commonly known in France as B. N. powder, and it did not occur to them that it might differ from the English explosive of that name. Under the circumstances it was allowed to be re-exported.

Guncotton.

Messrs. J. Clarke and Co. obtained a license (No. 522*a*) to import guncotton packed in the ordinary way. But they brought it in in the form of torpedo heads. As, however, the articles were for immediate exportation the offence was overlooked, but the importers were warned against a repetition of the same.

VonForster's Powder.

In November the Ballincollig Royal Gunpowder Mills Company, Limited, imported 100 lbs. of Von Forster's smokeless powder into Grimsby without a license. The explanations made by them as to the irregularity being deemed reasonable, they were permitted to take out an importation license to cover the consignment.†

Detonators.

The "Georg," with 28 cases of detonators from Bremen to New York, entered Southampton port on the 11th January, in a distressed condition, after having been in collision. The detonators were landed and isolated in a railway truck. They were ultimately bought by the British and Colonial Explosives Company, Limited, who took out an importation license to cover them.

Dynamite.

The "Douglas," with 90 tons of dynamite, in tow from Havre to Flushing, parted her tow rope in a gale, and drifted down channel into Portland. She was allowed to remain there until arrangements were completed for towing her to Flushing.

Ports for which importation licenses are granted.

Importation licenses, as explained in former Reports, are only granted (*a*) for those ports for which byelaws regulating a general trade in explosives have been duly made under the Act; and (*b*) where, in the opinion of Her Majesty's Commissioners of Customs, the duties of sampling cargoes devolving on the Customs officers can be

* As to the different policy which prevails in Germany, where dynamite not of German manufacture is forbidden to be carried by the State Railways, *see* note on p. 23, Annual Report for 1885.

† Grimsby Docks being closed to traffic in explosives, the importation license was only granted in view of the exceptional circumstances of the case.

conveniently discharged; and (*c*), in Ireland, those which are named in Orders made under the Peace Preservation (Ireland) Act, 1881, as ports into which explosive may be brought.*

A list of the ports in England, Wales, and Scotland for which importation licenses can at present be granted is given in Appendix L. The number of these remains the same as at the end of 1888, viz., 33. In Appendix L(*a*) is set forth a list of the ports in Ireland which are specified in the Orders under the Peace Preservation Act as those into which explosives, not requiring a license under the Act, may be brought.

Importations of gunpowder.

As the importation of gunpowder does not require a license, we receive no notice of any such importations; but the Statistical Department of the Board of Trade has been good enough to furnish us with information as to the importations of gunpowder which took place during the year, and this we have added to information derived from the same source and published in our Report for 1893; the figures thus collected show the transactions in the import of gunpowder from 1870 to 1894 inclusive. (*See* Appendix L(*b*).)

We have also appended tables showing the quantity and value of gunpowder exported from the United Kingdom during the same period, distinguishing that of British manufacture from that of foreign and colonial manufacture. (*See* Appendices L(*c*), L(*d*).)

V.

Government Inspection and Search.

We have seen no reason to modify the opinion we have expressed in former Reports, to the effect that the powers conferred on Government Inspectors by section 55, coupled with the powers of search and seizure conferred by sections 73, 74, and 75, are ample and satisfactory.

Proceedings instituted by Government Inspectors.

We have felt it necessary to institute proceedings in six cases which is below the average (8·0 per annum) for the previous 18 years from 1876 to the end of 1893, during which period we took proceedings in 144 cases. Convictions were obtained against all the six offenders, and fines amounting to 127*l.* 1*s.* were inflicted, in addition to costs. The particulars of these cases are given in Appendix T(*a*).

Proceedings instituted by Local Authorities on motion of Government Inspectors.

In addition to the above, proceedings have been taken by the Local Authorities on our motion, or on information supplied by us, in 14 cases, the particulars and results of which are given in Appendix T(*b*). This is below the average (20·4) of the previous 10 years. Thus, there were 27 such cases in 1884, 26 in 1885, 22 in 1886, 11 in 1887, 46 in 1888, 18 in 1889, 6 in 1890, 15 in 1891, 19 in 1892, and 14 in 1893.

In procuring the institution of proceedings by the Local Authorities or their officers we have been influenced by the considerations set forth in former Reports, which it is unnecessary to repeat here.

Seizure of explosives.

In addition to the cases in which we initiated the institution of proceedings of one sort or another, there were 11 cases in which explosive was placed by us, or at our instance, under seizure, in ten of which it was afterwards released without further action. (*See* Appendix U.)

The total number of cases of seizure of all sorts in which we were concerned was 20, the average for the previous 10 years being 28·6. But the decrease is not entirely due to improvement, as the number of our inspections during the year is less than the average for those years.

The following table gives the nature and amount of work in the way of inspections and other visits which we have accomplished during the year, and for convenience of comparison we have shown in italics the work performed in the 18 preceding years since the Act came into operation.

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* It should be particularly observed that it does not follow that all the Irish ports named in this list would be licensed for the importation of explosive, because some of them may not satisfy the conditions (*a*) and (*b*) specified in the text. The Order made by the Lord Lieutenant under the Peace Preservation Acts, dated 24th February 1893, relative to the Importation of Arms and Ammunition, named the following as the only ports into which Arms and Ammunition may be imported:—"Dublin, Belfast, Cork, "Limerick, Londonderry, Waterford, Galway, Sligo, Drogheda, Dundalk, Greenore, Newry, Wexford, Larne, "Carrickfergus, Glenarm, and Westport (Quay)." The expression ammunition is defined to mean:—"Bullets, "gunpowder, nitro-glycerine, dynamite, gun-cotton, and every other explosive substance, whether fitted for "use with any arms or otherwise."

DETAILED RETURN of INSPECTIONS and other VISITS from 1st January 1876 to 31st December 1894.

—	Factories.	Magazines.	Stores.	Small Firework Factories.	Registered Premises.	Places not classed.	Sites.	Inquests.	Inquiries.	Local Authorities.	Miscellaneous.	Total.
In 1894 -	192	419	84	4	202	—	—	5	7	75	131	1,119
In 1893 -	*205*	*406*	*42*	*10*	*134*	—	—	*5*	*4*	*3*	*45*	*854*
In 1892 -	*250*	*439*	*121*	*8*	*200*	*1*	—	*2*	*6*	*77*	*99*	*1,202*
In 1891 -	*254*	*401*	*89*	*8*	*282*	*1*	*1*	—	*1*	*94*	*80*	*1,211*
In 1890 -	*224*	*431*	*196*	*6*	*185*	*2*	—	*5*	*5*	*91*	*112*	*1,257*
In 1889 -	*197*	*431*	*191*	*9*	*299*	*5*	*3*	*3*	*3*	*132*	*141*	*1,414*
In 1888 -	*168*	*367*	*300*	*7*	*483*	*11*	—	*2*	*4*	*252*	*200*	*1,794*
In 1887 -	*235*	*448*	*232*	*26*	*302*	*7*	—	*8*	*7*	*130*	*184*	*1,579*
In 1886 -	*216*	*452*	*206*	*5*	*283*	*4*	*3*	*6*	*4*	*135*	*118*	*1,432*
In 1885 -	*170*	*417*	*275*	*7*	*392*	*15*	*2*	*7*	*4*	*138*	*200*	*1,627*
In 1884 -	*155*	*389*	*284*	*10*	*349*	*15*	—	*7*	*10*	*124*	*234*	*1,577*
In 1883 -	*139*	*345*	*215*	*6*	*319*	*14*	*3*	*8*	*10*	*134*	*198*	*1,391*
In 1882 -	*111*	*329*	*368*	*6*	*224*	*16*	*2*	*7*	*9*	*54*	*201*	*1,327*
In 1881 -	*107*	*163*	*192*	*6*	*89*	*2*	—	*6*	*7*	*83*	*191*	*846*
In 1880 -	*102*	*316*	*288*	*2*	*75*	*29*	—	*3*	*3*	*137*	*159*	*1,114*
In 1879 -	*91*	*220*	*319*	*8*	*43*	*16*	*2*	*8*	*9*	*99*	*169*	*984*
In 1878 -	*80*	*142*	*210*	*8*	*38*	*46*	*10*	*8*	*7*	*99*	*152*	*800*
In 1877 -	*57*	*215*	*215*	*9*	*17*	*117*	*7*	*8*	*6*	*241*	*101*	*993*
In 1876 -	*40*	*72*	*39*	*4*	*11*	*88*	*15*	*14*	*8*	*88*	*78*	*457*

It will be seen that we have managed to inspect every factory and magazine on our books at least once, and, in some cases, more than once. The number of our visits to the Local Authorities and the stores and registered premises is a large increase on that of 1893 and approximates to the average of former years.

One lecture to the local authority has been given by us during the year, viz., to the officers of the Oxfordshire Constabulary, including the officer of the city of Oxford.

Ground covered during our inspections. Counties.

In the course of our duties we have necessarily travelled over a good deal of ground, and on reference to our books we find that—

Of the 52 counties of England and Wales, we have visited 42
„ 33 „ Scotland, we have visited 18
„ 32 „ Ireland „ 10

Making a total out of the 117 counties in the United Kingdom of 70

in which we have made inspections and paid visits of various sorts during the year. (*See* Appendix M.) Of the unvisited counties the large proportion are agricultural counties where explosive is comparatively little used or kept.

Boroughs.

Appendix N enumerates the various boroughs and urban sanitary authorities which we have personally visited since the Act came into force, with a view to conferring with and assisting the Local Authority, or otherwise making observations as to the working of the Act therein.

The total number of boroughs so visited now amounts to 291.

Chemical work of the Department.

We have continued to have the benefit of the valuable services and extensive experience of Dr. Dupré, F.R.S., as the chemical adviser of the Department; and in accordance with our practice we submit *in extenso* that gentleman's report on the work which he has done for us during the year.

Westminster Hospital Medical School,
Caxton Street, S.W., 31st December 1894.

GENTLEMEN,

THE past year has, in several respects, been one of considerable activity. The total number of articles examined during the year, in what may be called the ordinary routine work, amounted to 295, an increase of 68 over the preceding year, while the number of articles included in Table II. amounted to 93, an increase of 49 over last year, giving a total increase of 117. In addition to this, there has been a revival of activity among inventors of explosives, and no less than nine new explosives and modifications of six explosives already licensed, were submitted during the year, and three new explosives remained outstanding from the preceding year.

The various articles examined are, as usual, given in two tables. Table I. contains all the samples of licensed explosives, or of materials used in the manufacture of such explosives; Table II. contains all articles examined which do not fall under either of these heads. In addition to the samples chemically examined, 28 other samples passed through my hands, but were examined only in regard to their physical condition, which in all cases was found to be satisfactory.

TABLE I.

Nature of Substance.	No. of Samples.		
	Passed.*	Rejected.	Total.
Amberite	1	—	1
Ammonite	2	—	2
Amorces	1	—	1
Ballistite	19	—	19
Bellite	3	—	3
Blasting gelatine	8	—	8
Brain's electric detonator fuze	1	—	1
B.N. smokeless powder†	1	—	1
Cannonite	1	—	1
Carbo-dynamite	1	—	1
Carbonite	15	5	20
Chilworth powder	3	—	3
Chinese crackers	2	—	2
Chlorate of potassium	1	—	1
C. L. powder	1	—	1
Coloured fires	4	—	4
„ stars	46	8	54
Cooppal's powder	11	—	11
Denaby powder	1	—	1
Dynamite	18	—	18
Electric detonator	1	—	1
Fireworks	4	—	4
Gelatine dynamite No. 1	32	1	33
„ „ No. 2	29	—	29
Guncotton	4	—	4
Igniting tapes	1	—	1
Matagnite gelatine	25	—	25
Nitrated guncotton	1	—	1
Nitro cellulose	1	—	1
„ cotton	2	—	2
„ paper	1	1	2
Oarite	1	—	1
Prismatic light	—	1	1
Rifleite	3	—	3
Roburite	1	—	1
Roman candle	4	1	5
Safety fuze	1	—	1
Schultze gunpowder	1	—	1
Securite	1	—	1
Signal light	2	—	2
Smokeless powder	1	—	1
Smokeless blasting powder	1	—	1
Stonite	1	—	1
Tonite	2	—	2
„ II.	1	—	1
„ III.	1	—	1
Von Forster's powder	1	—	1
Walsrode powder	6	—	6
Westfalite	6	—	6
Wetteren Powder	1	—	1
Wood-meal	2	—	2
Total	278	17	295

* Under the heading "Passed" are given, in the first place, the number of samples of the various explosives, the exact nature of which is defined in the license under which they are manufactured, which were found to comply with the conditions so laid down; and in the second place, the number of such other explosives or substances used in the manufacture of explosives, &c., &c., the nature of which is not specifically fixed by license, which were found free from any dangerous or objectionable features. Under the heading "Rejected" are given the number of samples which were found to be inconsistent with the terms of the license, or which contained some dangerous ingredient; for example, coloured fires, or fireworks containing a substance which would render them specially liable to spontaneous ignition.

† This explosive was imported under Importation License, No. 504, as B. N. powder. On examination it was found to be of a different composition. It was ultimately allowed to be re-exported.

TABLE II.

Nature of Substance.	Number.
Chlorate mixture	2
Débris	6
Fulminate of mercury	1
Hydrochloric acid	1
Methylated spirit	1
Miscellaneous	60
Nitric acid	4
Picric acid	1
„ „ Mixture	3
Signal rocket	7
Sulphuric acid	1
„ „ tubes	1
Wood-meal*	5
Total	93

* Experimental.

The condition of the various explosives examined during the year was, on the whole, highly satisfactory. The number of explosives proper, which had to be rejected, amounted to nine only out of a total of 214, or a trifle over 4 per cent. only; the lowest percentage since the beginning of my reports. Even this percentage, low as it is, was caused, all but entirely, by rejections among one kind of explosive; rejections not due to any defect in quality, but on account of the explosive not conforming in composition strictly to the license. There is, however, as will be seen farther on, still room for improvement.

Amorces. *Amorces.*—The only point of interest connected with these, as well as with igniting tapes, is the almost complete cessation of importations from abroad.

Blasting gelatine. *Blasting Gelatine.*—Although none of the eight samples of this explosive examined failed to pass the heat test at present laid down, I think it well to draw attention to the fact that a relatively large proportion stood the heat test for from 11 to 12 minutes only, or but very little above the limit allowed, whereas blasting gelatine can be manufactured to stand the test for 30 minutes and upwards. As this defect is not nearly so noticeable in samples of gelatine dynamite, it seems to show, putting aside the question of mere carelessness in manufacture, which is not a likely cause, that the method of manufacture adopted in some way injuriously affects its quality. I have no doubt that, having thus drawn attention to this defect, manufacturers will find a means for its removal, without overstepping the definitions of blasting gelatine as at present licensed.

Gelatine dynamite. *Gelatine Dynamite.*—The two varieties of this explosive again occupy the first place in regard to number of samples examined. It is all the more satisfactory to be able to report that the defect to which I drew attention last year, viz., too great a tendency to exudation, has almost disappeared, and one only, out of the 62 samples examined, had to be rejected on this account. Several other samples, however, also showed traces of exudation, though not to such a degree as would, in my opinion, constitute any danger, still I hope the time will come when even this slight defect will practically disappear.

Carbonite. *Carbonite.*—It will be seen that no less than five out of the 20 samples of this explosive examined are placed amongst the rejected samples. This, however, was not due to any dangerous quality shown by the samples, but to the fact that they

contained rather more nitro-glycerine than the licences permitted. The maximum percentage of nitro-glycerine permitted by the license has since been raised slightly. (*See* p. 22.)

Fireworks.

Fireworks.—In consequence of numerous accidents, traceable to the use of sulphur in chlorate mixtures, an Order in Council has been issued prohibiting the use of these two substances in the same firework mixture. The Order in Council comes into force, as far as concerns keeping, conveying, or selling, on 1st January, 1895, but as far as concerns the manufacture and importation it came into force on 1st June 1894.

It is highly satisfactory to know how rapidly and loyally the trade has accepted the new conditions. The difficulties anticipated by some, namely, that brilliancy of colour could not be obtained without the use of sulphur, seems to have been overcome by most manufacturers, and I feel sure that the trade will speedily recognise that the increased safety insured will more than repay them for the additional outlay, trouble and care demanded from them. A difficulty, which at first sight appears almost insurmountable, can be often successfully overcome when fairly faced. My suggestion to use perchlorate of potassium in place of chlorate has so far proved impracticable, in great measure owing to the fact that perchlorate mixtures take fire far less readily than chlorate mixtures. One further step in this direction seems, however, desirable, namely, to avoid, as far as possible, even mere contact between a chlorate and a sulphur mixture, at least one accident having been clearly traced to this cause.

The one roman candle placed among the rejected samples contained a star made with a chlorate-sulphur mixture, and the prismatic light is so placed, because in it a chlorate and sulphur mixture were in direct contact, a condition of things which, as I have stated above, has before led to accident.

Nitro paper.

Nitro Paper.—It is but right to state that the two samples of nitro paper examined were not manufactured for the purpose of being used in explosives.

None of the other explosives call for any remarks, except, perhaps, to notice their highly satisfactory condition.

New explosives examined during the year.

Britainite.—This is a mixture of nitrate of ammonium, nitrate of potassium, and a little chlorate of potassium with a solid hydrocarbon. It passed successfully through the preliminary examination. After the lapse of nearly a year a further sample was submitted for more special testing, and this is still under examination.

Britainite.

Plastomenite.

Plastomenite.—(Two samples). These are nitro-cellulose powders, containing nitrate of barium and a nitrated hydrocarbon. They were favourably reported on.

Schnebelite.

Schnebelite.—This explosive had passed successfully through the preliminary trial, and a report to this effect had been sent in on December 13th, 1893. Since then the explosive was submitted to a more prolonged and searching examination, in the course of which, like almost every chlorate mixture hitherto submitted, it developed certain features pointing to danger. Not only did it show a marked increase in sensibility to percussion and friction, but an appreciable portion of the chlorate became reduced to chloride. The final report on this explosive was therefore unfavourable.

Electronite.

Electronite.—This is Amberite No. 1 mixed with a considerable proportion of carbonate of ammonium. The powder suffered serious decomposition, even when kept at ordinary temperature, and was adversely reported on. Subsequently an application to be permitted to add a small proportion of carbonate of calcium to Blasting Amberite was favourably reported on.

Granulite.

Granulite.—This is a nitrated nitro-cellulose powder in the form of large irregular grains, thickly coated with paraffin. It was favourably reported on.

Normal smokeless powder.

Normal Smokeless Powder.—This is, practically, pure nitro-cellulose, gelatinized by means of acetate of amyle. It was favourably reported on.

Rosslyn smokeless powder.

Rosslyn Smokeless Powder.—Two varieties, No. I. and No. II. respectively. Practically four varieties of this powder were submitted, consisting of nitro-cotton of a special form, impregnated in one case (No. I.) with a nitrate and vaseline; in the other case (No. II.) with nitro-glycerine and vaseline. Each of these varieties were submitted undyed, and also dyed green. In the case of only one sample (No. I, undyed) was the report favourable. Subsequently an application for permission to add starch to this variety was favourably reported on. The remaining three varieties, viz., No. I., dyed green, and No. II., both dyed and undyed, were reported against.

Blasting amberite.

Blasting Amberite.—This explosive consists of Amberite No. II. with the addition of wood-meal. It was favourably reported on, under the usual conditions as to the character of the wood-meal to be employed.

Emerald powder.

Emerald Powder.—The proposed alteration consisted in dyeing ordinary Cooppal's Powder by means of malachite green (oxalate variety), and after careful testing this was favourably reported on.

Alterations in explosives already licensed.

Carbonite.—In consequence of adverse reports on a number of samples of carbonite, on account of their containing more than the licensed proportion of nitro-glycerine (25 per cent.), an application was made to allow an increase in the proportion of nitro-glycerine from 25 per cent. to 27 per cent. This application was, after careful examination, favourably reported on.

Smokeless Powder.—Two varieties were submitted, viz., one dyed yellow, the other blue. In neither case did the dye exert any injurious action on the stability of the powder, and both powders were favourably reported on.

Cooppal's Powder.—An application for permission to add hydrocarbons and resin to this powder, as licensed, was favourably reported on, and the old definition of Cooppal's powder has been altered accordingly.

Detonators.—In order to avoid the danger of any escape of fulminate from the cap, permission was asked to be allowed to fix the fulminate by covering it with celluloid, used either in the form of a previously prepared disk, fitting the cap, or in the form of a solution which, put on the top of the fulminate, will produce a layer of celluloid in the cap itself. No objections to this proposal were discovered on trial, and a favourable report was sent in.

Blasting Cartridges.—An application to be allowed to introduce small glass tubes filled with a strong solution of ammonia into gunpowder blasting cartridges with a view of diminishing the flame, was favourably reported on.

In last year's report (page 5) it was stated that collodion cotton would not, under certain strictly-defined conditions, be considered an explosive under the Act; as a necessary consequence collodion cotton not complying with these conditions will in future be ranked as an explosive. It therefore became necessary to draw up a definition of collodion cotton, and slightly to alter the definition of guncotton, hitherto adopted, and this has accordingly been done.*

Three other explosives submitted during the year are still under examination, viz. :—*Progressite*, a new kind of *Kolf's powder*, and, as already stated, a further sample of *Britainite*.

Correction.—In last year's report it was stated that the name of Troisdorf Powder had been changed to Chilworth Smokeless Powder. This is not the case, and Troisdorf Powder still retains its place as one of the licensed explosives.

Accidents.

A very interesting accident happened during the year on the premises of Mr. Hicks, Hatton Garden. Mr. Hicks had about 2½ years previously manufactured for a customer a peculiar kind of signal lights, which were to be fixed to the tail of a kite, and could at any time be set fire to while the kite was in the air by means of an electric current. Seven of these were left on Mr. Hicks's hands, and were hung against the outside of the south wall of his premises; there they had remained for 2½ years exposed to all weathers, when on June 17th two of them exploded. The explosion, beyond creating some alarm and breaking a few windows, did, fortunately, but little damage. The remaining five signals were at once put into water, and reached my hands on June 25th. The signals consisted of stout zinc tubes closed at the ends by screw taps, and had a number of holes round the tube, just below one of the caps, to allow the flame from the burning composition to issue. The tubes were charged with a mixture of chlorate of barium and shellac, a mixture which, as far as my experience goes, is not liable to spontaneous ignition. On the top of this composition was a small quantity of a priming containing sulphur and a small piece of quick match, inserted into which were the ends of a low tension electric fuze, the wires from which passed through the cap to be connected with wires running along the string of the kite. The fuzes of the unexploded signals were in order, except that, of course, the priming had

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* *See* p. 88.

been spoilt by immersion in water. There had been no thunderstorm or any kind of electric disturbance during the day, and no wires carrying electric currents were in the neighbourhood; the weather, however, had been very hot. The only cause that suggests itself in explanation was the close contact between the chlorate charge and the sulphur priming. I should, perhaps, have hesitated to ascribe the explosion to this cause had we not had positive proof that such contact will, under favourable conditions, lead to spontaneous ignition. I will also observe that chlorate of barium is more sensitive in this respect than chlorate of potassium (*see* remarks on the spontaneous ignition of chlorate mixtures, annual report for 1881, page 24).

Accident at Waltham Abbey.

Although not directly connected with your Office, I should like to be allowed to make a few remarks on the serious nitro-glycerine explosion which happened in May last at the cordite factory, Waltham Abbey, regarding the causes of which I was consulted by the War Office. The explosion undoubtedly originated in the nitro-glycerine washing-house, and thence extended to the nitro-glycerine store. The exact cause of the accident was not ascertained, but certain mechanical arrangements existing in the house at the time may, without unduly exaggerating probabilities, fairly be assumed to have been the cause of the explosion. I mention this accident here in order to repeat, once more most emphatically, my previously expressed opinion that the accident was not due to imperfectly manufactured or impure nitro-glycerine, and had absolutely nothing to do with any alleged dangerous qualities of cordite; on the contrary, the accident demonstrated, in the most striking manner, the safety of cordite under conditions which, with most other explosives, would have lead to a very serious spreading of the explosions.

Outrages.

Two explosions coming under this heading had some special features of interest which induce me to mention them here. The first of these, in which Bourdin lost his life, was no doubt brought about by the premature ignition of the explosive by strong sulphuric acid, which was to be used as a sort of time fuze. The second explosion, which happened in Tilney Street, was interesting, because, although the bomb exploded with considerable violence, when usually, if so-called high explosives are employed, all traces of the explosive, as well as of the means of ignition adopted, are lost, it was, nevertheless, possible to determine the nature of the explosive used, and to discover the means adopted for its ignition. The greater part of the bomb was also recovered, and afterwards pieced together by Her Majesty's Inspectors.

Experiments.

The series of experiments begun last year on the quality of wood-meal suitable for use in the manufacture of gelatine dynamite have been continued as occasion offered, but have not led yet to any decided results.

I remain, Gentlemen,
Your obedient Servant,
A. Dupré.

To Her Majesty's Inspectors of Explosives,
Home Office, Whitehall.

VI.

Working of the Act by the Local Authorities.

Working of the Act by the Local Authorities.

We have continued to devote as much attention as possible to the working of the Act by the local authorities during the year, and have visited 4 small firework factories, 84 stores, and 202 registered premises. We have thus been enabled to ascertain the general condition of these places in some districts.

We have in past reports entered very fully into the considerations affecting this branch of our work. We have but little to add to what has been said before. On the whole, improvement in the condition of the stores has been well maintained, and in some of the mining districts they are extremely well looked after.

As always, the registered premises form the most troublesome branch of our inspectorial duties; their number, their universal distribution, and, we must add, the extreme ignorance (real or feigned) of the occupiers, in many cases render it difficult for us to make much impression on them as a mass. Still, we can report that they are better looked after as a whole by the local officers than formerly, and that it is exceptional now to find large excesses of explosives stored on them. We find it useful, in the case of glaring irregularities, to cause the local officer to lay informations, and one or two convictions frequently have the good effect of stirring up to increased care, not only the occupiers in the borough or district, but also the local officers themselves.

Nine convictions for offences observed by us on registered premises will be found in Appendix T (*b*).

So far as our observations have gone during the past and preceding years, the following may be enumerated as among the more important districts and places in which an attentive and intelligent administration of the Act prevails:—Aberdeenshire, Argyll, Ayr, Cardigan, Carnarvon, Cornwall, Cumberland, Denbigh, Derby (parts of, especially the Repton and Gresley district), Devon (part of), Dumbarton, Durham (parts of), Edinburgh, Fife, Glamorgan, Inverness, Merioneth, Nottingham (part of), Lancashire (parts of, especially the Furness district), Leicester, Linlithgow, Lanark, Pembroke, Somerset (parts of, especially the Radstock district), Stafford (parts of), Stirling, Sussex, Warwick (parts of, especially the Nuneaton district). Westmorland, Yorkshire (parts of, especially the Cleveland district), and among the cities and boroughs, the Metropolis (especially that part of it which is under the control of the London County Council), Bath, Birmingham, Cheltenham, Edinburgh, Glasgow, Huddersfield, Leicester, Liverpool, Portsmouth, Manchester, Newcastle-on-Tyne, Nottingham, and Sheffield.

Other places, of which we have not had personal experience, might, perhaps, be added, and we hope that we shall find on revisiting places originally defective, to which we have not been for some years, that our former visits have borne fruit, and that substantial advance has been made.

Ireland.

The number of rural sanitary districts in which officers of the Royal Irish Constabulary are employed as local officers under the Act according to our last Return was 152, as against about 120 in 1886. This increase is of course satisfactory.

The number of districts in which officers other than those of the Royal Irish Constabulary are appointed was 271.

We have not obtained any further Return on these points during the past year.

Measures adopted for improving the administration of the Act by the Local Authorities.

We may here recapitulate the measures to which we habitually have recourse for procuring an effective administration of the Act by the Local Authorities, viz.:—

(1.) Visits to the Local Authorities as the time and opportunities for such visits may present themselves. We have, as stated, paid 75 of such visits during the year, and 2,186 during the 19 years that the Act has been in operation.

(2.) Explanatory lectures on the Act to the assembled officers of the Local Authorities. During the past year, as already stated, we have delivered one lecture (Oxford).

(3.) Inspection (where practicable in company with the officer of Local Authority) of Stores, Registered Premises, and Small Firework Factories, taken at random in the different districts in which we may be engaged. As already stated, we paid during the year 84 visits to stores, 202 to registered premises, and 4 to small firework factories.

Guide Book.

(4.) The Guide Book to the Act, which we prepared for the use of the Local Authorities, continues, we believe, to prove of very substantial assistance to those authorities and their officers, and is generally recognised as indispensable to the proper working of the Act. The seventh edition of this Guide Book is now on sale.

According to a return furnished by the Controller of H.M. Stationery Office, the number of copies of the Guide Book sold and supplied during the year was 265, making a total of 8,215 copies sold and supplied of all editions of this publication.

Local Government Acts.

In our report for 1890 we gave at some length the changes effected in the Local Authorities by the Local Government Acts, 1888 and 1889, for England, Wales, and Scotland. We reprint here a table showing the old and new state of things in both countries.

Local Authorities.

England and Wales.		Scotland.	
As under Explosives Act, 1875.	As under Local Government Act, 1888.	As under Explosives Act, 1875.	As under Local Government Act, 1889.
1. In the city of London, except as hereafter mentioned, the court of the lord mayor and aldermen of the said city.	1. As before (section 41).	1. In any borough, the magistrates and town council.	1. As before.
		2. In any harbour, as for (4) in England and Wales.	2. As before.
2. In the metropolis (that is, in places for the time being within the jurisdiction of the Metropolitan Board of Works under the Metropolis Management Act, 1855), except the city of London, and except as hereafter mentioned, the Metropolitan Board of Works.	2. London County Council replaces Metropolitan Board of Works.	3. In any place other than a borough or harbour as aforesaid, the justices of the peace for the county in which such place is situated.	3. The powers vested in the county justices pass to the county council without power of delegation.
3. In any borough in England which is not assessed to the county rate of any county by the justices of such county except as hereafter mentioned, the mayor, aldermen, and burgesses acting by the council.	3. As before as regards county boroughs and quarter sessions boroughs of over 10,000 inhabitants. Also boroughs of over 10,000 inhabitants created local authorities under section 68 of Explosives Act, but not boroughs of less than 10,000 inhabitants.		
4. In any harbour within the jurisdiction of a harbour authority, whether situate or not within the jurisdiction of any local authority before in this section mentioned, the harbour authority, to the exclusion of any other local authority.	4. As before.		
5. In any place where there is no local authority as above defined, the justices in petty sessions assembled.	5. The powers vested in the justices pass to county council with power of delegation to— (*a.*) A committee of its own body. (*b.*) To any district council, interpreted by section 100 to mean a rural or urban sanitary authority, until establishment of such district council by future Act of Parliament. (*c.*) To the justices of the county assembled in petty sessions.		

To aid the new bodies in their functions of granting licenses, &c., a memorandum was prepared for the Scottish county councils (at the request of the Office of the Secretary of State for Scotland), of which a copy was given in our last year's Report, and being useful for reference is here repeated. It is really applicable to the whole of the United Kingdom.

Memorandum on the Local Administration of the Explosives Act, 1875.

In making provision for the local administration of the Explosives Act, regard must be had to various classes of requirements and conditions arising under the Act:

Factory and magazine licenses.

(1.) There is the case of a trader who desires to establish a new factory or magazine (sections 6, 7, 8, 39), and who has for this purpose to obtain the assent of the local authority to a draft license issued by the Secretary of State. The procedure in this case must be as directed by section 7 of the Act; and it involves the publication by the applicant of a notice of the time and place appointed for the hearing not less than

one month before such hearing; and the Statute further requires the local authority to fix the time and place of hearing as soon as practicable after application has been made to them, and the time so fixed must be as soon as practicable after the expiration of the said month from the publication and service of the notices, and the final decision must be given by the local authority as soon as practicable after the expiration of the said month.

Store licenses.

Then there is the case of the trader who desires to obtain a license for a store (sections 15, 39).

In such a case no formal hearing is necessary. The grant of a store license ("as soon as practicable") is compulsory, if the proposed site, construction of the store, and amount of explosive to be stored therein are in accordance with the Orders in Council on the subject.

The necessary machinery for ascertaining these points requires therefore to be provided and would generally be forthcoming in the officers appointed by the local authority under the Act. (Section 69.)

Renewal of store licenses.

(3.) Then there is the case of the annual renewal of store licenses (sections 18, 39). Such renewal also is compulsory unless the circumstances have so changed as to invalidate the license, and no formal hearing is necessary for this purpose.* The machinery provided to deal with original store licenses would of course be adequate for renewals.

Registration of premises and renewal of registrations.

(4.) Then there is the case of the trader who desires to "register" his premises for the keeping of explosive, or to renew such registration. (Sections 21, 39.) Here again no formal hearing is necessary, the less so, as there is no power to refuse a registration or renewal. It rests with the local authority on receipt of a notice to register (or renew), with the necessary fee, to effect the required registration (28) and thus to open the premises to inspection. (Section 68.) Such notice, it is obvious, may very well be sent by post; indeed, the Act distinctly indicates in the case of renewals that the notice may be sent "by post or otherwise."*

Inspectorial and other duties.

(5.) Lastly, provision has to be made for the efficient local administration of the Act (section 69) by the appointment of officers (sections 69, 75), and the carrying out by them of the necessary inspections and search (sections 69, 73, 74, 75); the taking of samples (sections 69, 75, 76), and other duties of observation, inquiry, and report.

The official guide book to the Explosives Act, which is published by Her Majesty's Stationery Office, gives all necessary information as to the duties devolving on local authorities and their officers under the Act.

(Signed) V. D. Majendie,
Colonel,
H.M. Chief Inspector of Explosives.

Home Office,
1st August 1890.

Local Administration in Scotland.

With reference to the passage in our last Annual Report† as to the supposed effect of the 38th section of the Burgh Police (Scotland) Act, 1892, in effecting a transfer in police burghs of the powers under the Explosives Act, 1875, from the county council to the magistrates and police commissioners of such burghs), we are glad to be able to state that a decision of the Court of Session on the 20th March 1894, in the case of Tennent *v.* Commissioners and Magistrates of the Burgh of Partick, practically settles the question, as to which some doubt existed, in favour of the powers under the Explosives Act, 1875, continuing to be exercised as heretofore in burghs other than royal and parliamentary burghs by the county council,‡ and the evil results which we indicated would be likely to result from the distribution of jurisdiction (as opposed to concentration) will not now arise.§

Returns furnished during the year.

No returns of the licenses granted for Small Firework Factories and Stores, and of Premises Registered by the various Local Authorities of the United Kingdom, have been called for during the past year. We propose, however, as already stated, obtaining fresh returns this year.

Entry into premises without warrant.

Two reports have been received of the entry of officers of police without warrant under the provisions of section 73 during the year. In one case the entry was effected by the officer of the local authority under the Explosives Act, on the 13th October, and 2,487½ lbs. of explosive were seized on unregistered premises at Thorn Farm, Larbert, Stirlingshire. The occupier was prosecuted and fined 25*l.*, including costs. In the other case an officer of the police was instructed to search a house at Ystradyfodwg, Glamorgan, and he found 4 lbs. of gelatine dynamite, and some detonators. The occupier of the house was prosecuted and fined 1*l.* for keeping explosive without a police certificate.

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* The renewals can be simplified by the local authority arranging for them all to be effected on one date.

† Annual Report for 1893, pp. 22, 23.

‡ Of course, in any case in which the police burgh authorities had been specially declared the authority by Secretary of State in virtue of section 112, the commissioners of the burghs would in that case act as the local authority.

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VII.

Accidents.

The number of accidents by fire or explosion of which this Department has had cognizance during the year was 102, causing, so far as is known, 28 deaths and injuring 91 persons. Accidents.

But, as explained in former reports, the instructions issued to H.M. Inspectors of Mines in 1879 relieve them of the obligation of reporting any purely mining accidents with gunpowder, except in cases where it appears to them that the accident was of a character to call for an investigation by one of H.M. Inspectors of Explosives, or to afford information which seemed likely to assist these officers in the discharge of their duty.*

Accordingly, mining accidents with *gunpowder*, except when causing loss of life (when they should be reported by the coroner, or in Scotland by the procurator fiscal), or when of an exceptional character, do not come under our notice.

The number of accidents shows a considerable decrease, viz., 102 against 113, and this is largely below the average (130·1) for the last ten years. The number of deaths from accidents shows a decrease of four, viz., 28 against 32, being well under the decennial average (36·1). If we compare these figures with those of some former years the general improvement is very gratifying.

The number of persons injured last year was, we are glad to say, only 91, as against 104 in 1893. This also is below the average (104·9).

The following table shows the total number of accidents, and of persons killed and injured, during the past 10 years.

Year.	Number of Accidents.	Number of Persons	
		Killed.	Injured.
1894	102	28	91
1893	113	32	104
1892	149	28	126
1891	144	39	130
1890	132	44	85
1889	132	39	102
1888	123	37	97
1887	130	43	105
1886	143	40	136
1885	133	31	74
Total	1,301	361	1,050
Average for last ten years (1885–1894).	130·1	36·1	105·0

It is satisfactory to note that nearly two-thirds of the accidents (65) occurred in the use of explosives and under miscellaneous conditions to which the controlling provisions of the Act do not apply, and that such accidents are chargeable with no less than 25 out of the 28 deaths, and injured 69 out of the 91 persons returned as injured. (Table VII.)

This leaves us with a balance of only 37 accidents, causing 3 deaths and injuring 22 persons in manufacture, storage, and transport, these being the conditions to which the Act does apply. The result shows a considerable decrease (6 to 3) in the number of persons killed compared with the previous year, while the number of persons injured is also slightly decreased (30 to 22). The number of such accidents further shows a considerable reduction, viz., 46 to 37. (Table VII.)

Of the 37 accidents in manufacture, keeping, and conveyance, no less than 24 were unattended with personal injury, while of the 65 accidents in use, &c., only three came under our notice which were free from personal consequences. (Table I.)

The following tables, tabulating the accidents under the various heads, follow the arrangement which we first adopted in 1879, and appear to bring out clearly the various points, and to present all required information in a form convenient for reference and comparison.

* Annual Report for 1879, page 26.

SUMMARY OF ACCIDENTS.

TABLE I.—Showing ACCIDENTS of all sorts in 1894 grouped under the several heads of MANUFACTURE, KEEPING, CONVEYANCE, USE, and MISCELLANEOUS, but exclusive of the non-fatal, purely mining Accidents with Gunpowder, under H.M. Inspectors of Mines (*see* Text above).

SUMMARY.	Accidents causing Loss of Life and Bodily Injury.			Accidents not causing Loss of Life or Bodily Injury.	Total Number of Accidents.	REMARKS.
	No. of Accidents.	No. of Persons				
		Killed.	Injured.			
Manufacture - -	10	2	10	23	33	
Keeping - - -	3	1	12	—	3	
Conveyance - -	—	—	—	1	1	
Use and Miscellaneous* -	62	25	69	3	65	
Total - -	75	28	91	27	102	

* Under this head are included all accidents which occurred in the use of explosives, and immediately connected therewith; also accidents in thawing nitro-glycerine preparations, and others arising from miscellaneous causes not within the prohibitions of the Act. In short, this group comprises all accidents occurring under circumstances not immediately controlled by the Act, except the non-fatal, purely mining accidents with gunpowder, under the Inspectors of Mines.

TABLE II.—Showing the TOTAL NUMBER and NATURE of ACCIDENTS caused by each description of EXPLOSIVE in 1894.*

Class of Explosive.	Nature of Explosive.	Accidents causing Loss of Life and Bodily Injury.			Accidents not causing Loss of Life or Bodily Injury.	Total Number of Accidents.	REMARKS.
		No. of Accidents.	No. of Persons				
			Killed.	Injured.			
1. Gunpowder - -	Gunpowder* -	16	5	14	12	28	For the reference to the Index Nos. of the several accidents with each description of explosive, see the Tables grouping the accidents under the heads of Manufacture, Keeping, Conveyance, and Use and Miscellaneous. (Tables III., IV., V., VI.)
2. Nitrate-mixture -	—	—	—	—	—	—	
3. Nitro-compound:—							
Div. 1 - -	Ballistite - -	1	—	1	1	2	
	Carbonite - -	2	—	2	—	2	
	Dynamite - -	6	4	5	—	6	
	Nitro-Glycerine -	—	—	—	1	1	
	Blasting Gelatine -	4	3	2	—	4	
	Gelatine Dynamite	7	1	6	—	7	
	Gelignite - -	7	6	11	—	7	
Div. 2 - - -	Ammonite -	1	—	1	—	1	
	Guncotton - -	4	—	4	2	6	
	Roburite - -	1	—	1	—	1	
	E.C. Powder -	—	—	—	1	1	
	Tonite or Cotton Powder.	3	7	2	—	3	
	Schultze Powder and Gunpowder.	1	1	10	1	2	
4. Chlorate-mixture -	—	—	—	—	—	—	
5. Fulminate - -	—	—	—	—	—	—	
6. Ammunition:—							
Div. 1 - -	Cartridge† - -	1	—	1	—	1	† For elephant shooting.
	Fog signal -	1	—	1	—	1	
Div. 2 - - -	Detonators -	16	1	23	2	18	
	Electric Detonator fuze.	1	—	1	—	1	
7. Firework - -	Fireworks -	3	—	6	6	9	
Unknown, Unlicensed, or Doubtful.	—	—	—	—	1	1	
	Total -	75	28	91	27	102	

* Exclusive of the non-fatal purely mining accidents with gunpowder under H.M.'s Inspectors of Mines.

TABLE III.—Showing the TOTAL NUMBER and NATURE of ACCIDENTS in MANUFACTURE with each description of EXPLOSIVE in 1894.

Manufacture.

Class of Explosive.	Nature of Explosive in course of Manufacture.	Accidents causing Loss of Life and Bodily Injury.			Accidents not causing Loss of Life or Bodily Injury.	Total Number of Accidents in Manufacture.	Index Nos. in List of Explosions. (*See* Appendix W.)	REMARKS.
		No. of Accidents.	No. of Persons					
			Killed.	Injured.				
1. Gunpowder -	Gunpowder -	1	—	2	11	12	7,* 15,* 20,* 21,* 28,* 31,* 39,† 40,* 50,* 82,* 92,* 93.*	* Incorporating mills. † Fire.
3. Nitro-compound	Gelignite - -	1	2	—	—	1	61.	
	Ballistite - -	1	—	1	1	2	6, 68.	
	Nitro-Glycerine -	—	—	—	1	1	78.	
	Guncotton - -	—	—	—	2	2	29, 37.	
	E.C. Powder -	—	—	—	1	1	23.	
	Tonite or Cotton Powder.	1	—	1	—	1	36.†	
	Schultze Powder -	—	—	—	1	1	63.†	
6. Ammunition								
Div. 1 -	Fog signals -	1	—	1	—	1	86.	
Div. 2 -	Electric Detonator Fuze.	1	—	1	—	1	18.	
Div. 3 -	Detonators -	3	—	3	2	5	12, 47, 51, 75, 90.	
7. Fireworks -	Fireworks -	1	—	1	4	5	33, 60, 70, 77, 84.	
	Total -	10	2	10	23	33		

TABLE IV.—Showing the TOTAL NUMBER and NATURE of ACCIDENTS in the KEEPING of the different descriptions of EXPLOSIVES in 1894.

Keeping.

Class of Explosive.	Nature of Explosive.	Accidents causing Loss of Life and Bodily Injury.			Accidents not causing Loss of Life or Bodily Injury.	Total Number of Accidents in Keeping.	Index Nos. in List of Explosions. (See Appendix W.)	REMARKS.
		No. of Accidents.	No. of Persons					
			Killed.	Injured.				
1. Gunpowder -	Gunpowder -	—	—	—	—	—	—	
2. Nitrate-mixture -	—	—	—	—	—	—	—	
3. Nitro-compound	Schultze Powder and Gunpowder.	1	1	10	—	1	73	
4. Chlorate-mixture	—	—	—	—	—	—	—	
5. Fulminate -	—	—	—	—	—	—	—	
6. Ammunition -	—	1	—	1	—	1	65*	*Cartridge for elephant shooting.
7. Firework -	—	1	—	1	—	1	83	
	Total -	3	1	12	—	3		

TABLE V.—Showing the TOTAL NUMBER and NATURE of ACCIDENTS in CONVEYANCE of the different descriptions of EXPLOSIVES in 1894.

Conveyance.

Class of Explosive.	Nature of Explosive.	Accidents causing Loss of Life and Bodily Injury.			Accidents not causing Loss of Life or Bodily Injury.	Total No. of Accidents in Use and from Miscellaneous Causes.	Index Nos. in List of Explosions. (See Appendix W.)	REMARKS
		No. of Accidents.	No. of Persons					
			Killed.	Injured.				
1. Gunpowder -	Gunpowder -	—	—	—	—	—		
7. Firework -	Fireworks -	—	—	—	1	1	1.	
	Total -	—	—	—	1	1		

TABLE VI.—Showing the TOTAL NUMBER and NATURE of ACCIDENTS occurring in the USE of the different EXPLOSIVES, and under MISCELLANEOUS CIRCUMSTANCES in 1894.*

Use and Miscellaneous.

Class of Explosive.	Nature of Explosive.	Accidents causing Loss of Life and Bodily Injury.			Accidents not causing Loss of Life or Bodily Injury.	Total No. of Accidents in Use and from Miscellaneous Causes.	Index Nos. in List of Explosions. (See Appendix W.)	REMARKS.
		No. of Accidents.	No. of Persons					
			Killed.	Injured.				
1. Gunpowder -	Gunpowder -	15	5	12	1	16	3, 8, 11, 25, 26, 30, 34, 44, 59, 71, 74, 80, 85, 87, 89, 94.	
2. Nitrate-mixture	—	—	—	—	—	—	—	
3. Nitro-compound	—	—	—	—	—	—	—	
Div. 1	Dynamite	6	4	5	—	6	14, 19, 24, 27, 72, 76.	
	Blasting Gelatine	4	3	2	—	4	5, 45, 79, 97.	
	Gelatine Dynamite including Geligenite.	13	5	17	—	13	4,* 9, 16,* 17, 32,* 35, 41, 43,* 55, 67, 91,* 96, 98.	* With geligenite.
	Carbonite -	2	—	2	—	2	100, 101.	
Div. 2	Tonite - -	2	7	1	—	2	2, 49.	
	Roburite -	1	—	1	—	1	53.	
	Ammonite -	1	—	1	—	1	10.	
	Guncotton -	4	—	4	—	4	48, 52,* 54,* 58.*	* And gunpowder.
4. Chlorate-mixture.	—	—	—	—	—	—	—	
5. Fulminate -	—	—	—	—	—	—	—	
6. Ammunition:—								
Div. 1 -	—	—	—	—	—	—	—	
Div. 2 -	—	—	—	—	—	—	—	
Div. 3 -	Detonators -	13	1	20	—	13	13, 22, 42, 46, 56, 57, 62, 64, 69, 81, 95, 99, 102.	
7. Firework -	Fireworks -	1	—	4	1	2	38, 88.	
Unknown or Unlicensed.	—	—	—	—	1	1	66.	
	Total -	62	25	69	3	65		

* Under this head are included all accidents which occurred in the use of explosives and immediately connected therewith; also accidents in thawing dynamite, and others arising from miscellaneous causes not within the prohibitions of the Act. In short, this group comprises all accidents occurring under circumstances not immediately controlled by the Act, except the non-fatal purely mining accidents with gunpowder, under H.M.'s Inspectors of Mines.

TABLE VII.—ACCIDENTS arranged in GROUPS, according to whether they fall within or without the controlling provisions of the Act; with the results in former years, for the purposes of comparison.

	Year.	Accidents causing Loss of Life and Bodily Injury.			Accidents not causing Loss of Life or Bodily Injury.	Total No. of Accidents.
		No. of Accidents.	Killed.	Injured.		
A. Accidents in Manufacture, Keeping, and Conveyance; being those which occur under conditions to which the controlling provisions of the Act are intended to apply -	1894	13	3	22	24	37
	1893	19	6	30	27	46
	1892	23	3	27	48	71
	1891	25	5	29	37	62
	1890	17	8	17	50	67
	1889	17	8	16	40	57
	1888	19	6	24	35	54
	1887	22	12	22	45	67
	1886	20	2	22	58	78
	1885	21	7	18	64	85
	1884	23	15	25	46	69
	1883	24	8	30	84	108
	1882	18	13	22	59	77
	1881	20	12	19	52	72
	1880	20	3	22	37	57
	1879	16	7	22	14	30
	1878	20	11	23	27	47
B. Accidents in Use and under Miscellaneous circumstances; being those which occur under conditions to which the controlling provisions of the Act are *not* intended to apply -	1894	62	25	69	3	65
	1893	65	26	74	2	67
	1892	76	25	99	2	78
	1891	80	34	101	2	82
	1890	65	36	68	—	65
	1889	73	31	86	2	75
	1888	68	31	73	1	69
	1887	58	31	83	5	63
	1886	64	38	114	1	65
	1885	47	24	56	1	48
	1884	74	36	113	1	75
	1883	62	31	79	2	64
	1882	68	38	76	1	69
	1881	50	27	63	1	51
	1880	51	29	45	1	52
	1879	47	13	61	4	51
	1878	66	29	69	1	67

TABLE VIII.—Showing the ACCIDENTS in MANUFACTURE, KEEPING, CONVEYANCE, USE, AND MISCELLANEOUS respectively, in each of the last Ten Years.

	Manufacture.			Keeping.			Conveyance.			Use and Miscellaneous.			Total.		
	No. of Accidents.	No. of Persons killed.	No. of Persons injured.	No. of Accidents.	No. of Persons killed.	No. of Persons injured.	No. of Accidents.	No. of Persons killed.	No. of Persons injured.	No. of Accidents.	No. of Persons killed.	No. of Persons injured.	No. of Accidents.	No. of Persons killed.	No. of Persons injured.
1894 - -	33	2	10	3	1	12	1	—	—	65	25	69	102	28	91
1893 - -	38	6	21	6	—	6	2	—	3	67	26	74	113	32	104
1892 - -	67	2	24	3	1	3	1	—	—	78	25	99	149	28	126
1891 - -	55	1	23	5	3	6	2	1	—	82	34	101	144	39	130
1890 - -	64	8	15	3	—	2	—	—	—	65	36	68	132	44	85
1889 - -	52	7	13	5	1	3	—	—	—	75	31	86	132	39	102
1888 - -	50	6	16	3	—	8	1	—	—	69	31	73	123	37	97
1887 - -	63	8	18	3	4	4	1	—	—	63	31	83	130	43	105
1886 - -	73	1	18	5	1	4	—	—	—	65	38	114	143	40	136
1885 - -	80	5	15	4	2	3	1	—	—	48	24	56	133	31	74
Total -	575	46	173	40	13	51	9	1	3	677	301	823	1,301	361	1,050
Average for last 10 years.	57·5	4·6	17·3	4·0	1·3	5·1	0·9	0·1	0·3	67·7	30·1	82·3	130·1	36·1	105·0

Inquests.

During the past year we attended five inquests on persons killed by accidents in connexion with explosives (sec. 65); but in a considerable number of cases we have been in correspondence with coroners on the subject, and have afforded them such explanations and assistance with reference to past experience as seemed likely to be useful.

Inquiries.

Of Inquiries under section 66 we have held three, as follows :—

Consecutive No. of Report.	Nature of Accident.	Date of Report.
CVIII.	Explosion of Tonite in the Solent on 19th July, 1894 (explosion No. 49, 1894.) (Colonel Ford).	30th July 1894.
CIX.	Explosion of Gelatine Dynamite in process of mixing, at the Factory of the National Explosives Company, Limited, Hayle, on the 4th September, 1894 (No. 61, 1894.) (Colonel Ford).	22nd October 1894.
CX.	Explosion in Cartridge Filling Room on Registered Premises, Darlington, on the 9th October, 1894 (No. 73, 1894). (Captain Thomson, R.A.).	25th October 1894.

The foregoing are exclusive of certain Confidential Reports on the Greenwich and Tilney Street explosions, and other outrages or attempts. They are also exclusive of the part taken by Her Majesty's Chief Inspector of Explosives (as a member of a War Office Committee) in the preparation of two voluminous reports on the Waltham Abbey accidents of the 13th December, 1893, and the 7th May, 1894, and of a Report by the same Committee on the construction, application, &c. of the danger buildings at Woolwich Arsenal.

The total number of Inquiries since the Act came into operation is 109,* the results of which are embodied in reports which are presented to Parliament, and communicated to a number of the leading newspapers and persons immediately interested. For the list of all such reports from the coming into operation of the Act, until the present time (*see* Appendix Q.).

Accidents in Factories.†

Accidents in factories for explosives. (Tables III., VIII.)

Dealing first with the accidents in factories, the record is, we are pleased to say, in every way a favourable one. Not only is the number of such accidents astonishingly small, viz., 33 only, being largely below the average (57·5) for the last 10 years, and less than in any previous year since the Act came into operation, but of these 33 accidents, no less than 23 were unattended with personal injury, while the number of deaths caused by the remainder was 2 only, with 10 persons injured. In both these particulars the results are largely below the averages for the past ten years, which stands as follows: deaths, average 4·6; injured, average 17·3.

We would submit that these results furnish grounds for the liveliest satisfaction, whether we regard the low ruling averages for the decade, or the still lower actual figures for the past year.

We would venture, once again, for the purpose of enabling the gain which has resulted from the operation of the Explosives Act to be adequately appreciated, to recall the figures which we set forth in our 1885 Report, showing that during the seven years immediately preceding the Act, an annual average of no less than 39·5 deaths obtained, even on very imperfect returns. But even this comparison, striking as it is, by no means exhausts the cousiderations which the present improved state of affairs suggests. For the results recorded for the years preceding the Act coming into operation were derived (on imperfect non-compulsory returns) from 55 factories. The results now recorded are derived from 130 factories—with the very large augmentation in the number of persons employed therein—the trade having expanded to this extent during the 19 years the Act has been in operation. Moreover, a large proportion of the new factories deal with entirely new classes of explosives, and therefore with new forms of risk, and when this is considered, the beneficial results of the Act in respect of the saving of life in manufacture becomes still more notable. The point, indeed, is not one which is it is necessary to labour, for however we regard it, the broad result of

* The number of Reports, however, is two in excess of the number of Inquiries, because two of them (Nos. IVA. and XVI.) relate to what were not strictly or formally Inquiries under section 66. And the fact of one of these Reports being numbered IVA. makes the total number of Reports one in excess of the highest consecutive number of such Reports. This is exclusive of numerous Confidential Reports.

† This does not include accidents in "rooms" appropriated or in use for the manufacture of small arm cartridges in connexion with magazines, stores, or registered premises, in virtue of Section 46 (*see e.g.*, Accident No. 73, under the head of "keeping"), or in the preparation or adaptation of explosives in "workshops" connected with magazines or stores, in virtue of Section 47, or the illegal manufacture of explosives in unauthorised places.

the figures we have given must be regarded as eminently satisfactory. That we should be able to record that out of a total of certainly over 10,000 persons engaged throughout the year in the manufacture of explosives* only two have met their deaths and ten have sustained injury speaks for itself.

Accidents in the manufacture of gunpowder. (Table III.)

The accidents in the manufacture of gunpowder were 12 in number, being an increase of two on the previous year; but, as in that year, they were happily unattended with loss of life, and only two persons (as against four in 1893) sustained injury. These figures compare very favourably with the average for the last 10 years, as the subjoined table will show; indeed, the accidents in this branch of the trade were really insignificant, all except one (39) having occurred in incorporating mills, the one exception having been a fire in a charcoal store. Not only was this fire one with *unground* charcoal, but it is not a little noticeable that this is the third fire which has occurred in this factory (Herodsfoot, Cornwall), and, we believe, in this particular house, with *un*ground charcoal. Only two possible causes can be suggested, viz., spontaneous ignition (though in *un*ground charcoal such an occurrence is very far from being a likely one), or some fire may have remained in the stick charcoal, though the manufacturers of the charcoal strongly deny the possibility of this.

The mill accidents call for no special notice. In only one case (31) could a cause be definitely assigned, viz., a fallen screw, and with regard to this we may remark that a precaution which we have recommended for adoption as a preventative of this class of risk proved extremely useful at the Chilworth factory recently—a nut or screw having, we are informed, fallen on to the tray which on our advice had been affixed above the runners to prevent any falling nuts or screws from finding their way on to the mill bed.

The following table gives the losses in gunpowder factories since 1885 inclusive :—

Year.	No. of Accidents.	No. of Persons	
		Killed.	Injured.
1894	12	—	2
1893	10	—	4
1892	18	—	1
1891	14	1	4
1890	16	8	2
1889	18	1	1
1888	19	3	5
1887	16	5	1
1886	20	—	2
1885	23	4	—
Total	166	22	22
Average for last ten years.	16·6	2·2	2·2

Accidents in the manufacture of nitro-compounds. (Nos. 6, 23, 29, 36, 37, 61, 63, 68.)

Of accidents in the manufacture of the very important group of explosives ranked as nitro-compounds there have been nine, being an increase of one on the former year, but while the number of deaths resulting from these accidents was the same in each year, viz., two, the number of persons injured has been sensibly less, viz., two only in 1894 as against six in 1893.

Indeed, with one exception, the accidents have been generally insignificant.

Explosion of gelignite at Hayle Factory. (No. 61.)

The one exception was the accident (61) which occurred on the 4th September at the factory of the National Explosives Company at Hayle, during the manufacture or mixing of that variety of gelatine dynamite No. 2, known as gelignite. That accident (which is the single fatal accident in the manufacture of explosives during the year) formed the subject of an Inquiry and Special Report (No. CIX.), of the more material parts of which the following is a brief summary :—

This explosion took place, as stated, on the 4th September, and by it two men lost their lives.

* We are unable to give the exact figures, as we have obtained no fresh returns since 1890, when the figures stood at 9,820 employed in factories, exclusive of some 200 more in small firework and toy firework factories (the accidents in which are included in our list).

The explosive which was being manufactured at the time was gelignite (a variety of gelatine dynamite, No. 2), and the process which was being carried on in the building consisted of a preliminary hand-mixing in leaden tanks by means of a wooden "spud," from which it was transferred to a machine, in which the operation was completed. Two men were engaged in the building at the time, and as they were both killed, it was impossible to ascertain with certainty the cause of the accident; but, among the probable causes, it appears that a foreign substance in the machine holds the first place.

Some defects in the arrangements were brought to light in the course of the inquiry, which are fully pointed out in the Report.

Accident in the manufacture of nitro-glycerine. (No. 78.)

An accident (78) which occurred at Ardeer in connexion with the manufacture of nitro-glycerine, although insignificant, is interesting, as illustrating, the extreme sensitiveness of that explosive to a glancing blow under certain conditions. The accident occurred while two men were engaged in emptying a barrel which had been used for washing the muddy remains derived from the nitro-glycerine manufacture; the barrel slipped, and it is believed that the slight explosion which followed was due to a small drop or smear of the nitro-glycerine adherent to the outside of the barrel, probably assisted by grit. No one was hurt.

Accidents in the manufacture of ballistite. (Nos. 6, 68.)

Ballistite is chargeable with two slight accidents; one a fire only, which occurred at Chilworth during the rolling and incorporation of a charge of ballistite between steel rollers. The action of the drenchers, which had been supplied in view of possible accidents of this sort, which German experience showed were likely from time to time to occur, proved entirely satisfactory, and beyond the destruction of the charge no sensible damage was done.

The other accident (68) which occurred in the laboratory at Ardeer, was of a most insignificant character, involving the explosion of only a few grammes of a sample of ballistite, which the chemist was sealing in a glass tube by means of a Bunsen burner.

Fuming-off of acid centrifugals. (Nos.29, 37.)

Two instances (29, 37) occurred of the fuming-off of acid centrifugals at Stowmarket, in the manufacture of guncotton. A few years ago accidents of this sort were not infrequent, and our reports for 1886, 1887, and 1888 record several.* As many as five occurred at the same factory in 1887. The matter will be found fully discussed, with the results of some experiments carried out at our suggestion by the then Superintendent of Waltham Abbey, where also ignitions of this character had occurred, a large proportion of them having been distinctly attributable to the accidental presence of drops of oil (other than mineral oil) in the centrifugal, or to a greasy knot. Such accidents were also shown to be much more frequent in warm weather than in cold.†

Fires in manufacture of tonite, Schultze, and E.C. powders. (Nos. 23, 36, 63.)

The remaining accidents were all fires, and in only one case (23) was the fire of at all a serious character. In this case the fire originated in a sifting machine in the E.C. Powder Factory. The quantity of E.C. powder present at the time was about 500 lbs., of which 30 lbs. was in the sifting machine, while the rest was in tin bottles or receptacles. The whole of the powder in the building was destroyed, but without explosion; the building was completely gutted, the roof fell in, and some of the machinery was destroyed. No one sustained injury, a result which under the circumstances must be regarded as eminently satisfactory.

The accident (63) in the manufacture of Schultze powder, did not involve any explosive, but was a fire only. A quantity of non-nitrated wood fibre was destroyed.

The accident (36) in the manufacture of tonite, consisted merely in the ignition of some methylated ether which a work person was carrying in the laboratory.

Having regard to the enormous quantity of nitro-compounds manufactured in this country, it is, we think, a legitimate cause for satisfaction that the accidents in their production should have been so few and (with one exception) so insignificant, six out of the nine having been fires only without explosion.

Accidents in the manufacture of ammunition. (Table II.)

The accidents in the manufacture of the large and varied group of explosives ranked as "ammunition," show a notable decrease as compared with 1893, viz., 7 against 12; while the figures for 1893 compared extremely favourably with those of former years (as *e.g.*, 1892, when there were 24).

And happily also in the past year none of the ammunition accidents proved fatal, whereas in 1893 two deaths occurred in this group, viz., at Messrs. Joyce's factory (105/1893).

* Annual Report for 1886, pages 32–3, 53; for 1887, page 33; for 1888, page 36.

† *See* Annual Report for 1886, pages 53, 54.

With reference to that accident, which occurred quite at the end of the year, it may be well to mention, that in pursuance of our expressed intention to exercise such powers as the Act gives us to enforce the universal adoption of what is known as the "jelly-bag" system of mixing dry detonating composition, or some other equally protective system, we sent to the occupier of every factory where highly sensitive detonating compositions have to be prepared dry a copy of the Special Report (CVII.) on the accident in question, together with a covering letter, requiring such occupier to state whether, in view of the circumstances of the recent accident, as set forth in this Report, and the satisfactory experience which has been obtained of the value and efficiency of the "jelly-bag" mixing system, he would be prepared, in the event of his not already having done so, to take steps to entirely substitute this or some other not less efficient arrangement for hand mixing.* (*See* Appendix S.)

Enforced adoption of "jelly-bag" (or equivalent) system of mixing detonating composition.

Turning to the accidents with detonators for the year, we find, indeed, little to call for special notice. These accidents which show a marked reduction in number on some former years† were generally of a very ordinary character, testifying on the one hand to the extremely sensitive and delicate character of this manufacture (*see e.g.*, accidents 75 and 90), and to the efficiency of the precautions now observed for minimizing effects. In one case (12) the accident was the result of a direct violation of the rules, and the offender suffered doubly in being injured by the accident and in being, very properly, discharged from his employment.

Detonator accidents. (Nos. 12, 47, 51, 75, 90.)

The only accident (18) in the manufacture of electric detonator fuzes seems to have been immediately due to the violation of the general rule, which forbids the employment in a danger-building of a boy under 16 years of age, except in the presence and under the immediate control of a grown-up person. We therefore felt it our duty to recommend proceedings against Mr. Moore (the occupier), and a conviction was obtained and suitable penalties were imposed (Appendix T (*a*)).

Accident with electric detonator fuze. (No. 18.)

The only accident (86) in the manufacture of fog-signals which has been reported to us during the year, occurred, as is usual, during the operation of pressing. We have repeatedly suggested to the manufacturers of fog-signals the desirability of affixing to the press a suitable screen, whereby, in the event of the signal exploding, the operator would escape injury. In the large majority of such factories screens of this character have been adopted with excellent results.

In the factory where the accident now under notice occurred one of us had pointed out a short time previously to the occupier, who we gladly add has always displayed great readiness to adopt suggestions, that the screens which he had provided were not thoroughly efficient, and he had at once taken in hand the provision of screens of a more effective character. But the accident took place before the new screens had been fitted. They have now, we understand, been provided throughout the factory.

Accident in manufacture of fog-signals. (No. 86.)

The number of accidents in the manufacture of fireworks was exactly the same as in the preceding year, viz., 5; but in their results the accidents in 1894 were far less serious than those in 1893, which caused two deaths and injured seven persons.

In the year just past no one was killed, and only one person was injured, by accidents of this class.

Accidents in the manufacture of fireworks. (Nos. 33, 60, 70, 77, 84.)

One of these accidents (60) was interesting as furnishing an undoubted case of spontaneous ignition. It occurred at Mr. Isaac Crane's newly established factory near Bristol. About 6 lbs. of yellow stars had been placed to dry on a zinc tray over a hot-water heater, and after a lapse of about half an hour they ignited, setting on fire some 5 lbs. of red fire composition, also drying on paper in the same building. No one was present in the building at the time.

We examined samples of the red fire and yellow stars. The former was a shellac fire (without sulphur), and did not in the opinion of our chemical adviser present any elements of instability. The yellow stars consisted of oxalate, chlorate, and nitrate of sodium, barium, and potassium, with shellac and realgar. The admixture is not one of

* *See* Annual Report for 1893, page 32.

† In 1883 no less than 45 of such accidents occurred, while from 20 to 30 was a not uncommon annual total.

‡ *See, e.g.*, Annual Report for 1893, page 32, where the following passage occurs:—"Only four accidents "are reported to have occurred in the manufacture of fog-signals during the process of pressing; and, as "none of these caused personal injury, they furnish further and satisfactory evidence of the protective "value of the screens, of which we have succeeded in procuring the adoption in the large majority of fog-"signal factories."

which we have had previous experience, and we have been unable to obtain from other sources any evidence as to its liability to ignite spontaneously. It is true that Tessier mentions that oxalate of sodium should not be mixed with nitrates, but only on the ground that, by double decomposition, nitrate of sodium would be formed, which salt is hygroscopic. He does not state that the oxalic acid might be oxidized, and thus give rise to danger. The stability of any mixture which, in the presence of water, is liable to spontaneous ignition would, if it contained a nitrate, be thus endangered by the addition of oxalate of sodium, but apparently such addition would not, under other conditions, be objectionable from this point of view. The subject is one, however, which will receive further examination at our hands, for in the present case spontaneous ignition undoubtedly occurred, and suspicion points rather to the yellow stars, as the comparatively unknown element, than the red fire.

Two accidents (33, 70) occurred in the charging of rockets. The first of them took place at Messrs. Penly's Small Firework Factory; the other occurred at Mr. Isaac Crane's Factory. In neither case was it possible to assign a cause, though in accidents of this sort the cause which most readily suggests itself is grit or other foreign substance present in the composition or introduced on the end of the drift.

In the case of another accident in charging (77), which occurred at Messrs. C. T. Brock and Co.'s Factory, it was found possible to assign a cause with reasonable confidence. The firework in process of charging was a "jewel fountain," and it is suggested that the accident resulted from the charger putting in an unduly small quantity of what is known as "first fire" composition, thus enabling the end of the drift (which was split) to come into contact with the flat top of the gun-metal nipple; and it is supposed that one of the pieces of coloured stars which are introduced into these fireworks to produce the "jewel" effects, had got between the drift and the nipple, and being highly sensitive, had ignited.

The only firework accident attended with personal injury was one (84) which occurred at Messrs. Hammond's Firework Factory, at Edinburgh, while the son of the occupier was carrying out some experiments with a new description of maroon or shell-signal for marine use. It is alleged that, contrary to the instructions of the occupier, a composition containing chlorate of potash, instead of ordinary gunpowder, was being used; and while the wooden top was being fitted on to one of the signals it exploded, doubtless from friction, injuring the hand of the operator so severely as to necessitate its amputation.

In connexion with the subject of firework accidents, it may be well to refer here to the remarks in the "Manufacture" Section of this Report on the steps which have been taken to prevent the continued use in firework manufacture of compositions containing sulphur and chlorates.*

Theatrical pyrotechnics.

It may be well to notice here in connexion with the accident (81, 1893) which occurred at the Theatre Royal, Eastbourne, through the explosion of a small quantity of an admixture of magnesium with chlorate of potash, used in producing lightning and other pyrotechnic or explosive effects,† that the whole subject of the use of explosives or *quasi* explosives in theatres and public places of amusement has occupied the attention of the London County Council, who have, through their inspectors, fully informed themselves as to the practice at the different theatres, and have taken such steps and made such suggestions as appeared to them to be called for in the interests of the safety of the performers and the public; and all such places are to be visited not less than once in six months, with a special view to the continued observance of the various suggestions, precautions, and the narrow limitation of quantities.‡

Accidents in Keeping.

Accidents in the keeping of explosives. (Table IV.) (Nos. 65, 73, 83.)

The accidents in the keeping of explosives (Nos. 65, 73, 83) are, so far as numbers go, exactly half those in 1893. But whereas in 1893 no one was killed and only six were injured, we have this year to record one death and injury to 12 persons—a result which is rather above the average of the past ten years, so far as the number of injured goes, but in other respects is below the average (Table VIII.).

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* *See* p. 6.
† Letter from London County Council (covering detailed Reports), 26th June 1894.
‡ *See* Annual Report for 1893, pages 40, 41.

The one accident of serious consequence (73) which formed the subject of an Inquiry and Special Report,* occurred on 9th October at the premises of Mr. Smythe, gunmaker, Darlington, causing the death of one person, and injury to ten others. Explosion on registered premises at Darlington. (No. 73.)

The explosion took place in a room appropriated to the filling of small-arm cartridges. The only person in the room at the time, a boy 15 years of age, was killed, and it was, therefore, impossible to ascertain the cause with certainty. There is, however, little doubt that the loose powder present in the room became ignited, either by a spark from the boy's hobnailed boots, or by some boyish experiment which he was carrying out.

The explosion involved some 40 lbs. of gunpowder in a safe which opened into the room, and of which the door must have been ajar, and also about 20 lbs. of small-arm nitro-compound in an adjoining cupboard. The damage done was very considerable, several buildings being completely wrecked, burying their occupants in the débris.

In another case (65) a boy sustained slight injury from the explosion of some 8-bore cartridges intended for elephant shooting, which had been filled by Messrs. Holland and Holland, of New Bond Street, London, at their premises at Kensal Green, and brought to Bond Street to be repacked for exportation. While one of the cases was being lifted on to a wooden bench by a boy, he let it fall, and out of the 100 cartridges it was found that nine had exploded. The cartridges contained each a 10-dram charge of gunpowder and a steel-pointed leaden bullet, and they were packed lengthwise, so that the bullet of one pressed against the cap of another, and the fall of the box, it is supposed, produced sufficient concussion to fire one of the caps (by the bullet of the neighbouring cartridge), and that this explosion extended to the other cartridges. Explosion of 8-bore cartridges intended for elephant shooting. (No. 65.)

The London County Council investigated the matter, and have been in communication with the firm concerned, and it has been arranged that in future the cartridges will be packed vertically, one layer in each box, instead of horizontally in layers (with several in each box) as heretofore, thus removing the particular risk to which it cannot reasonably be doubted the accident now under notice was due.

Precautions, by means of racks fitted for the reception of single cartridges, will be adopted in the filling rooms to protect the caps from impingement against the nose of a bullet or other hard substance.

It is, we think, obvious from this accident that cartridges of these dimensions and containing so heavy a charge can hardly, in future, be accepted as "safety cartridges" within the meaning of the Act, as evidently they are not free from a liability to communicate explosion—whereas it is the essence of the definition of safety cartridges that they shall be wholly free from any such liability.†

The remaining accident (83) in keeping explosive—if, indeed, it can properly be called an "accident" at all, was of an insignificant character, and was due to the occupier of registered premises at Thirsk letting off a cracker at the door of his shop, which at the time contained a number of fireworks, which became ignited. The occupier was slightly burnt, and damage was done by fire to the shop and premises. Explosion of fireworks on registered premises. (No. 83.)

Accidents in Conveyance.

The only accident (1) in the conveyance of explosive was one which occurred in the Railway Receiving Office, Pentonville Road, Clerkenwell, on the 10th January, and was fortunately unattended with personal injury. It was caused by the fracture of some small capillary tubes containing sulphuric acid, and enclosed in a packet also containing a chlorate mixture (readily ignitable by sulphuric acid) wrapped in "lightning paper." The articles are used in theatres for the production of sudden flashes of light of different colours. In this case proceedings were on our recommendation instituted against the offender, resulting in a conviction and the infliction of a substantial fine. (Appendix T(*a*)). Accident in the conveyance of explosives. (Table V.) (No. 1.)

The case is almost identical with the accident (No. 38, 1887) which occurred on the 30th April, 1887, in a shop in Great Queen Street, W.C., through the breaking of a similar tube and the resulting ignition of some chlorate mixture packed in the same parcel together with a few pounds of gunpowder, and which was being carried by a boy in the employ of Mr. H. Cadwell, pyrotechnist. The boy placed the parcel, probably roughly, on the counter, when the ignition and explosion occurred. Although

* Special Report, No. CX.

† *See* definition of "Safety Cartridges" in Section 108.

proceedings were in this case instituted against Mr. Cadwell, by the railway company over whose line the parcel had been conveyed, they unfortunately fell through, owing to the lapse of time between the offence and the institution of the proceedings.*

Accidents in Use, and Miscellaneous.

Accidents in the use, &c. of explosives. (Table VI.)

The accidents grouped under the head of Use and Miscellaneous (Table VI.), were, we are pleased to say, rather less numerous than in 1893, viz., 65 as against 67, but the number of deaths was only one less, viz., 25 as against 26. The number of persons injured, however, showed a more material reduction, from 74 to 68.

It is proper again to recall an observation of former years as to this being a class of accident in which, from the imperfect character of our information and other causes, the annual fluctuations are liable to be considerable, and also the more important remark that this is a class of accident to which the controlling provisions of the Act do not directly apply, and in respect of which we have therefore no actual responsibility. The Act does not control the use of explosives, and all we can do is to study the different accidents occurring under this head, and extract from them as much information and instruction as they may be capable of furnishing, and apply the same (by way of suggestion) for the benefit of those concerned in the use of explosives.

There have been 16 accidents in the use, &c. of gunpowder (against 18 in 1893), and these accidents caused 5 deaths and injured 12 persons. The whole of these figures are, we are glad to say considerably below the average, as the following table shows :—

Accidents in the use, &c. of gunpowder. (Table VI.)

	No. of Gunpowder Accidents.	Deaths.	Persons Injured.
1894	16	5	12
1893	18	9	20
1892	24	13	31
1891	29	15	32
1890	24	21	18
1889	27	14	38
1888	26	14	25
1887	33	18	32
1886	27	21	63
1885	24	8	32
Total	248	138	303
Average for last 10 years 1885 to 1894.	24·8	13·8	30·3

N.B.—*In some of the foregoing instances gunpowder was associated with other explosives, and in those cases the accident is generally returned as a "gunpowder" accident, though gunpowder may not in all cases have been the originating cause.*

The gunpowder accidents have been generally of a very ordinary character : explosions due to fire or spark (3, 8, ? 25, 34, 71, 89) of which accident 34 was a signal example of criminal carelessness (*see* Appendix W.); children playing with gunpowder (30, 44, 59, 74, 87, 94). In the case of accident 74, which occurred through some children breaking into an insufficiently secured magazine at a licensed but temporarily disused fog-signal factory, we have required the occupiers of the factory, so long as it is in disuse, to keep the magazine and all the other buildings wholly free from explosives. The improper use of an iron rammer caused one of the accidents (80) ; the hang fire of a fuze another (11) ; while the premature action of a fuze proved fatal in another case (3). Few years pass without one or more persons being killed or injured by the bursting of some sort of improvised cannon, fired at a 5th of November celebration, or at other festivities, and the year just passed was no exception, one person having been killed by the bursting, at Bishop's Auckland on "Guy Fawkes Day," of such a cannon, formed out of gas-piping (85).

Accidents in the use of nitro-compounds. (Table VI.)

Of accidents in the use, &c. of the very large and important group of explosives ranked as nitro-compounds, we have, as usual, a considerable number, viz., 33, causing 19 deaths, and 33 cases of bodily injury, all which figures show a slight increase on

* Annual Report for 1887, pp. 36–7, 117–8.

those for 1893, a result which may probably be in part attributed to the increasing use of these explosives.

Dealing first with accidents due to the first division of this class, *i.e.*, to nitro-glycerine preparations, it appears that 25 of this class came under our notice, causing 12 deaths and injuring 26 persons.

Accidents with explosives of 1st division of nitro-compound class. (Table VI.)

On the whole this result is not unsatisfactory, especially if regard be had to the continual increase in the use of explosives of this large and important class.

The following table shows the results during the past 10 years :—

	No. of Accidents.	Deaths.	Persons Injured.
1894	25	12	26
1893	26	14	23
1892	26	9	33
1891	30	12	45
1890	24	12	30
1889	32	13	33
1888	22	14	20
1887	17	10	21
1886	22	15	29
1885	14	11	10
Total	238	122	270
Average for 10 years	23·8	12·2	27·0

Of thawing accidents we have had, happily, only two (14, 17) during the year, both of which proved fatal, and both of them told the same story, viz., the use, contrary to emphatic warnings and definite instructions, of improvised or improper thawing apparatus.

With a view to keeping this prolific source of accident well before the eyes of the public, we have brought up to date and repeated (in Appendix X.) the list we have recently given of thawing accidents. And this list shows up to the present time a total of 74 such accidents, causing 62 deaths, and injuring 89 persons; of which deaths and personal injuries it may be fairly said that every one of them would have been avoided if the instructions so carefully issued, and the warnings so emphatically repeated in our reports and by the agents of the leading manufacturers of nitro-glycerine preparations had been regarded.*

As usual, the use of undue force or of improper tools in ramming, occupies a prominent place among the sources of accident (27, 35, 91, 97, 98, 101). In the case of accident 35 it will be observed that an *iron* rammer was being used, while in the case of accident 97 some measure of the unduly violent character of the ramming is suggested by the fact that the man was forcing home a cartridge which had stuck by means of a wooden pole 6 ft. long and 1½ in. diameter. The resulting explosion drove the pole through the unfortunate man's body, and the end (which projected 3 ft. from his back) had to be sawn off by the doctor before he could be removed.

The other cases, one of which (101) included one of "carbonite," were cases of explosion while using wooden rammers. But in the carbonite case the force was being applied to a charge which contained a detonator.

We regret to find that accidents from the presence of unexploded charges or portions of charges (4, 5, 16, 19, 55, 79, 96) have been very fruitful this year, viz., 7, causing 2 deaths, and injuring no less than 11 persons.

We will here reproduce a passage on this subject which has found a place in former reports :—

"It is too much to hope that accidents from this cause can ever be wholly got rid of; indeed, even with the best precautions, they are not easy to avoid, but much may be done by a recognition of the fact (of which many persons engaged in blasting appear to be ignorant) that the risk from this source is of an appreciable and even formidable character. Among the precautions which might usefully be adopted to avert or diminish it would be the use of *wooden* tools for turning over or disposing of débris from any blast with high explosives when there is the slightest ground for suspecting any incompleteness in the explosion of the charge."

* *See* on this subject Annual Report for 1886, pp. 38–40; 1890, p. 39; 1891, pp. 35, 36; 1893, pp. 38, 39 Special Reports, LXXII. and XCII.

Delayed action of a fuze caused one accident only (67), the circumstances of which are sufficiently explained in the Accident Appendix.

The six accidents from prematures (10, 26, 41, 43, 45, 96) caused 2 deaths, and injured 6 persons. In one case (43) the blasting was being carried out by electricity, and the accident was caused by the current being inadvertently and prematurely turned on. The other accidents under this head were plainly chargeable rather to the fuze than to the explosive.

One man was killed and one injured by projected débris (24, 100). The accident (72) due to the use of a lamp is rather an uncommon one, the fuze of a charge having accidentally become ignited by a lamp carried by one of the men, and this being unobserved, one of the workmen went back and was in the immediate vicinity of the blast when it went off.

The two remaining accidents with nitro-glycerine preparations (9, 32) can only be set down to gross carelessness.

Accidents in the use of explosives of 2nd division of nitro-compound class. (Table VI.)

Unfortunately, the record of accidents with explosives of the second division of the nitro-compound class is a long and serious one. There have been 8 of such accidents (2, 10, 48, 49, 52, 53, 54, 58), and in one case (49) no less than 7 lives were lost.

Explosion of tonite in a boat in the Solent. (No. 49.)

This accident (49) occurred on the 19th July in a boat belonging to the Corporation of the Trinity House. The Trinity House, as the lighthouse authority for England and Wales, is empowered to remove wrecks and employ explosives for their destruction. The men whose lives were lost by this accident had been engaged in dispersing the wreck of the "Azalea," which had run aground on the Brambles Shoal, and had with them in the boat, in addition to three charges which had not been required, a 20-lb. charge of tonite, which had failed to explode under water, and in which the detonator still remained. This charge had been recovered by one of the men contrary to the instructions of the Trinity Superintendent. The circumstances are detailed at length in a Special Report, No. CVIII., from which it will be seen that after the last charge had been fired the men were returning to the site of the wreck in a boat, followed by another boat containing the Trinity Superintendent, when the explosion occurred; 5 of the men were killed instantaneously, while the remaining 2 survived only a short time after they were picked up. In the course of the Inquiry it appeared that there could be little doubt that one of the men brought about the explosion by attempting to remove the detonator from the charge which had been recovered. The Inquiry brought numerous irregularities to light, notably the storage of explosives in lightships without a license, and the dangerous practice of breaking up electric detonator fuzes in order to extract the detonators therefrom for use with ordinary safety fuze.

The coroner also failed to adjourn the inquest as required by the Explosives Act.

The remaining 7 accidents with this class of explosive were none of them fatal (though they caused injury to 7 persons), nor, indeed, are they of a character to call for special notice. Three of the accidents (48, 52, 53) were due to the unexpected presence of unexploded charges or portions of charges; there were two accidents (10, 58) from prematures; one (54) from projected débris; and one (2) to which no definite cause can be confidently assigned.

Accidents with detonators. (Table VI.)

The only accident in the use, &c. of explosive of the ammunition class were those which occurred with detonators (13, 22, 42, 46, 56, 57, 62, 64, 69, 81, 95, 99, 102); these were again rather numerous viz., 13, and, as usual, were for the most part of a comparatively slight character. But in one instance (46), in which a number of detonators went off in a man's pocket on his inadvertently introducing a lighted pipe, a fatal result followed; and in one or two other instances (13, 69, 102) the accident caused injury to more than one person. Accident 42 was a curious one, having been due to a man engaged in removing a wreck getting his feet accidently entangled in some chains or iron work; seeing that the charge would explode before he could extricate himself, he pulled the fuze away with his hand; this saved the explosion of the charge, but not that of the detonator, whereby he sustained injury.

With one other exception (99), in which no definite cause can be assigned, all the accidents with detonators were caused by children playing with them, picking out the composition with a pin, or striking the detonator with a hammer, or trying to set fire to it.

Accidents in the use of fireworks. (Nos. 38, 88.)

So far as we are aware the accidents in the use of fireworks have been very few and inconsiderable, viz., two only, injuring four persons.

The accident (38) which occurred in Hatton Garden on the 16th June was a curious one. The circumstances are set forth in some detail in Appendix W., but it may be stated briefly here that one or more of the lights, which were of an experimental character, having been supplied for trial between two and three years ago, and suspended during this period exposed to all weathers against the south wall of the house, took fire, evidently spontaneously, for the premises were closed at the time and no other discoverable source of ignition was to be found. An investigation of the circumstances showed that the signal had contained a charge of green fire mainly composed of chlorate of barium and shellac, and in contact with or embedded in this were some strands of ordinary quick-match (*i.e.*, cotton impregnated with gunpowder), and it is surmised that the ignition proceeded from the contact of the sulphur in the gunpowder with the chlorate in the green fire. The case bears a strong resemblance to the case of ignition of some green lances at Messrs. Pain's factory, in 1890, which was clearly shown to have been due to the contact of a composition containing chlorate of barium with one containing sulphur.* The case appears further to assist our conclusions as to the importance of forbidding the use of chlorate and sulphur in the same composition or in intimate contact, though it is to be feared that the terms of the Order in Council, No. 15, on this point would not reach a case like this.

Accident with experimental life-saving signals. (No. 38.)

Another accident (88), attended in this case with injury to four persons, has to be added to the list of those caused by socket signals,† though it must be admitted that in this instance little if any blame attaches to the article itself. It appears that a person discharged a socket sound signal from the top of a house in a street at Liverpool, using an old tin canister as a socket. The article (which in some accounts is spoken of as a "sound signal rocket") ascended only a short distance and fell into the street, where it exploded, injuring four children who were standing in the street at the time, and breaking some windows. Proceedings have been instituted against the persons who fired the signal but have not yet been concluded.‡

Accident from socket sound signal. (No. 88.)

Only one accident (66) with an unknown, doubtful, or unauthorised explosive came under our notice during the year, and that was a case at Barnsley, where the bottom and side of a grate were blown out by an explosive in the coal, due it is surmised (as has not infrequently happened before) to some unexploded portion of a charge used in coal-getting, and which had remained unnoticed in the coal.

Accident with unknown explosives. (No. 66.)

Government Accidents.

Some small accidents, scarcely to be dignified by the name of "explosions," have occurred at the Government Cordite Factory, Waltham Abbey, in the process of pressing cordite; and the following may serve as a type of this class of accident:—

Waltham Abbey.

A cylinder of a squirting press was being filled with paste in a hydraulic ramming machine, when a pretty loud explosion, "considerably louder than that of a rifle," took place. The man working the machine says he was either knocked down, or in starting back, fell down, most probably the latter. On examination, nothing was found wrong with the machine. The cylinder on being taken out appeared to be full of paste, about 1 lb. On removing the latter, a small space was found over the wire gauze, and under the column of paste, and from the smell it was evident that the explosion had occurred there. The paste was carefully examined, but no trace of anything likely to do harm could be found.

Although an accident of this character might, if developed, have produced serious results, the circumstances in this case, as in other similar cases which have occurred, appear, if anything, rather to testify to the safety, or rather perhaps non-sensitiveness, of cordite, so far as communicated explosive effects are concerned; for in the case above noticed, there was, as has been explained, a small quantity of the paste exploded, while the remainder, though under considerable pressure, was unexploded. The quantity exploded was, no doubt, very small, for the plunger had not been forced back against the slight water pressure (not exceeding 150 lbs. per square inch), nor was the paste ejected from the cylinder.

It has not been possible to assign a definite cause for these small explosions; they may have been due to a small hard knot in the dry guncotton, which had escaped

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* Annual Report for 1890, p. 35; Special Report No. XCIV.

† *See* Annual Report for 1893, page 43.

‡ Whilst this Report has been in the press the case has been decided, and a penalty of 2*l.* and 4*s.* 6*d.* costs inflicted.

gelatinisation by the acetone, becoming fired by friction; or they may have been due to the presence of some foreign substance producing explosion by physical, or even, perhaps, by chemical causes.

Explosion at Royal guncotton Factory, Waltham Abbey.

An explosion occurred in the Guncotton Factory, Waltham Abbey, on 1st March, which resulted in the injury, more or less severe, of three persons.

Mr. Findlay, master worker to the gunpowder factory, was carrying out an experiment to determine whether the degree of nitration of guncotton can be raised by re-dipping the finished material in strong acid.

For this purpose he placed 1 lb. of dry guncotton in a stoneware pot, and poured in 13½ lbs. of mixed acids. He then commenced to stir with an iron spatula. The guncotton exploded somewhat violently and severely injured Mr. Findlay, while two men who were assisting were slightly hurt.

Dr. Dupré, who investigated the case for the War Department, came to the conclusion, that some portion of the guncotton escaped immersion in the acids, and became sufficiently heated to explode. He considers that under any circumstances re-dipping guncotton in fresh acids is a more or less dangerous operation.

Explosion at Cam House of Waltham Abbey Factory, 13th December 1893.

The very serious explosion of gunpowder which occurred on the 13th December 1893, at No. 2 Cam House, Waltham Abbey, and to which we adverted in our last Annual Report,* by which nine lives were lost and one man was injured, has formed the subject of a very full and careful inquiry by a War Office Committee, of which Lord Sandhurst was Chairman, and Sir Frederick Abel, Colonel Majendie, and Colonel Lloyd were members.

The proceedings of the Committee, with the evidence in the case, are embodied in a Blue Book which has been presented to Parliament, and in which all the circumstances connected with the Inquiry will be found to have been exhaustively considered.

The conclusion to which the Committee arrived in regard to this particular accident is embodied in the following paragraph:—

"The Committee regret that they have not found it possible on the evidence to arrive at a more definite conclusion as to the precise cause of the accident. The most careful attention they have been able to bestow on the subject does not enable them to do more than to say that in their judgment it is unlikely to have resulted from the defective working of the machines, seeing that they were found in good working order after the accident, but that it most probably arose from one of the three following causes:—

"1. The use or fall of a tool or implement.
"2. Lucifer matches.
"3. Presence of grit or other foreign substance."

But the Committee add that although the result of the Inquiry has not enabled them to place their finger confidently upon the actual cause of the accident of the 13th December, it "has served the useful purpose of bringing to light very grave "defects in the system of discipline and precautions prevailing at Waltham Abbey, "and the urgent necessity for a comprehensive revision of the regulations, and for "the adoption of disciplinary measures for their more rigorous enforcement."

And the Committee signalise the following as among the defects which came most prominently under their notice:—

1. The excessive number of persons in the Cam House.
2. Defective system of search.
3. Inadequacy of the existing system of supervision of danger buildings.
4. Grave defects in system of repairs of machinery and use of tools.
5. Insufficient precautions for the safe disposal of oily rags and cloths.
6. Defective arrangements for the exclusion of grit.
7. Taking meals in the "shoe holes" (of danger buildings).
8. Unsatisfactory character of existing rules.
9. The absence of a proper system of penalties.
10. The necessity for the revision of regulations as to limitation of quantities.
11. The defective construction of some danger buildings.
12. The necessity for a better system with regard to handing over danger buildings for repair.

The Committee signalises the foregoing as "the more prominent defects which this Inquiry has brought to light," but they add that they wish emphatically to guard

* *See* Annual Report for 1893, pages 43 and 44.

against the impression that these defects constitute an even approximately exhaustive list. But the rectification of these defects and the remodelling of the system which has hitherto prevailed at Waltham Abbey is, however, not one with which Her Majesty's Inspectors of Explosives are officially concerned.

In connexion with this accident and the suggestion emanating from more than one quarter that the machines were to blame, we thought it desirable to issue a letter of inquiry to manufacturers, with a view to eliciting the results of their experience of this class of machine (*see* Appendix O). The replies were very divergent, and will be found on pp. 67 and 68 of the Report of the War Office Committee. For convenience of reference, however, we have thought it desirable to print the abstract of these replies in Appendix O.

Explosion of nitro-glycerine in Waltham Abbey factory, 7th May.

Unfortunately, a further and more formidable accident, and one, which although not attended with so serious a loss of life, caused very much greater destruction of property, has occurred since, viz., on the 7th May last. This accident proved fatal to four persons, while about 20 other persons sustained personal injuries, generally of a slight character.

This accident was inquired into by the same Committee as had been appointed for the consideration of the gunpowder explosion of December, 1893, and the Report of the Committee has similarly been embodied in a Blue Book and presented to Parliament.

The explosion took place at 4.8 p.m. on Monday, 7th May, 1894, in that part of the factory on Quinton Hill, Waltham Abbey, where the manufacture of nitro-glycerine (for cordite) is carried on. There were, in fact, two explosions, viz., one in the building described as "washing house" in the plan of the Quinton Hill factory, and one in the building situated 61 yards to the south of the washing house, and described as "nitro-glycerine store." The two explosions were so simultaneous as to have led many persons who were near the spot to believe that only one had actually occurred, whilst those witnesses who heard the two testify to their having succeeded each other at an almost inappreciably short interval.

The following particulars are quoted from the Report :—

"As regards the two exploded buildings, it may be stated in general terms, that "they were wooden structures, with tarred felt roofs, each one being surrounded "on all sides by high brick-revetted earth traverses as shown in the plan hereto "annexed.

"In the washing house were carried out (by arrangements to be hereafter "more particularly described) the final washing and purification (to test) of the nitro-"glycerine, and the filtration of the purified material. The purified and filtered nitro-"glycerine was run down a V-shaped leaden gutter in a wooden tunnel to the second "of the exploded houses shown as the "nitro-glycerine store" on the plan, and here "the nitro-glycerine was stored, and afterwards weighed out into charges which were "poured on to weighed charges of gun cotton preparatory to removal for incorporation.

"The quantity of nitro-glycerine present in the washing house at the time of the "explosion was about 1,500 lbs.; in the nitro-glycerine store there was about "2,200 lbs. The total quantity which exploded was thus about 3,700 lbs. or not "far short of two tons.* No explosion occurred in any other houses of the factory "distant from 37 to 462 yards.

"The falling glass and débris from the roofs, &c. cracked or broke a number of the "earthenware nitrating pots in the neighbouring guncotton factory, and admitted the "water to the gun cotton in process of digestion in the acids, thereby causing the same "to fume off.

"In the nitro-glycerine factory, a quantity of this liquid in process of separation "(from the acids) in No. 2 nitrating house had a narrow escape, as the building was "considerably injured, and débris fell into the separating tank, none of which, "fortunately, appears to have been wood or of a carbonaceous character (being chiefly "or entirely glass), otherwise this charge could hardly have escaped explosion. Mr. "William Thomson, one of the chemists at the works, was managing the nitro-glycerine "factory in the temporary absence of Mr. James Thomson, he was about 300 yards away "in a building in the cordite factory at the time of the explosion, and sustained some "injury, but with great presence of mind, he immediately proceeded, assisted by others, "to let the contents of the separating tank down into the drowning tank (provided for "emergency), and there washed the nitro-glycerine until all danger of explosion was

* In weighing explosives 2,000 lbs. is reckoned as a ton.

" removed. Through the promptitude and skill of Mr. William Thomson a further " explosion was probably averted.

" The Committee carefully examined the question of whether the originating explosion " occurred in the washing house or in the nitro-glycerine store, and the result of their " examination brings the Committee to the conclusion that the explosion certainly " originated in the washing house.

" A very detailed examination of the various risks present, or liable to have been " present, and a careful examination of the evidence of experts and others did not enable " the Committee to say positively to which of the various possible causes the accident " was due, but they consider that it is, on the whole, most probably to be found among " four special risks, viz. :—

" 1. Risk from a blow or friction due to the fall or violent movement of the leaden " skimmer.

" 2. Risk from use of earthenware cocks.

" 3. Risk from friction established by the leaden air pipe.

" 4. Risk from the fall or use of some article commonly present in the washing " house."

The Committee append some general observations in regard to the regulations affecting the factory, which, in their judgment, call for comprehensive revision in the direction indicated for the gunpowder factory regulations in the former report. And they also state that they are strongly impressed with the urgent necessity for the immediate adoption of measures for :—

(*a.*) Re-distributing the buildings of the present factory in such a way as to conform to reasonable conditions of safety ; and

(*b.*) Adapting (which must mean reducing) the output to the conditions of the factory when such re-distribution has been effected ; and

(*c.*) Establishing a duplicate factory on some suitable and separate site.

It may, in conclusion, be well to quote a passage from this Report, dealing with the question of how far this accident would be regarded as a cordite explosion. On this point the Committee remark as follows :—

" As this accident has been more than once described in the public press and " elsewhere as a ' cordite explosion,' and has indeed been referred to as illustrative " of the great risk attending the manufacture of cordite, and even as establishing to " some extent the unsuitability of that material for service-purposes, the Committee " think it desirable to point out, most emphatically, that it was not a cordite explosion " at all. It was an explosion of nitro-glycerine pure and simple, and an explosion " which might equally have occurred whatever the ultimate destination of the nitro- " glycerine ; whether it was intended to be used in the manufacture of dynamite, " blasting gelatine, or any one of the numerous explosives into which nitro-glycerine " enters as a constituent. It would be as unreasonable to set down to the discredit " of fireworks an explosion of gunpowder which was being manufactured with a view " to its being ultimately employed elsewhere in making squibs or crackers, as it is to " debit cordite with an explosion of nitro-glycerine, merely because such nitro- " glycerine was destined, when its manufacture was completed, to be elsewhere worked " up into cordite. Percussion caps have not hitherto acquired a reputation of being " unsafe or unreliable articles, because accidents have happened in the manufacture " of the fulminate of mercury used in their preparation, or even in the mixing of the " detonating composition with which they are filled.

" In the present case it happens, as a matter of fact, that the explosion, so far from " justifying doubts or suspicions, furnished remarkable and most instructive testimony " as to the relative safety of cordite.

" Although the cordite factory, which, it should be noted, is distinct from the " nitro-glycerine factory (although in the judgment of the Committee injudiciously " near to the same), and under separate management, was situated only from about " 60 to 300 yards from the explosion, and was in full work at the time, and although " the buildings were greatly shattered and many persons within them sustained injury " from falling or projected débris, not a particle of cordite even took fire, still less " exploded. Even more striking testimony to the relative safety of this material, as " compared, for example, with black gunpowder or even with guncotton, is afforded " by the fact that a building (known as guncotton stove, No. 1) distant only 85 yards, " which was used for drying cordite, and which contained at the time 3,000 lb. of that " material in process of drying by hot air, although almost completely broken up and " crushed in by the explosion, was not exploded, none of the cordite being even

" ignited or in any way injured, except by the impingement of falling débris. The " Committee therefore think it their duty to make the fact generally known, that this " accident, so far from impairing confidence in cordite or of presenting considerations " to its possible disadvantage, has afforded powerful testimony to the comparative " inertness of the material.

" The risks attending the manufacture of nitro-glycerine are generally known and " well recognised, as also are those which attend the manufacture of guncotton (at " any rate when it has reached the dry stage), and it was never supposed that these " risks would disappear, any more than it would be reasonable to believe that they " would be enhanced, when the nitro-glycerine or dry guncotton happened to be " destined for conversion into cordite. In the present case there occurred an explosion " of nitro-glycerine and an ignition of guncotton, during the processes of their " manufacture; but there was no explosion nor even ignition of these substances, " either when in process of being combined, or when actually combined, to form " cordite, although the conditions were in some respects (and especially in the case of " the cordite which was being dried in 'No. 1, guncotton stove'), *primâ facie* so " favourable to ignition or explosion that, with the majority of explosives, one result " or other would almost certainly have ensued."

River Medway.

On the 1st March an outbreak of fire occurred on board the old frigate " Leonidas," lying in the River Medway off Upnor, near Chatham.

The vessel is attached to the naval branch of the Chatham Gun Wharf, and is used for the storage of guncotton and submarine mines. The forepart of the vessel was discovered in flames, but the fire was got under by a party of sailors belonging to the Steam Reserve.

There were, it was stated, only two men on board the vessel (the staff of keepers having recently been reduced), and both of them had lain down to rest.

The origin of the fire was a mystery, as the foreman in charge of the explosives on board thoroughly searched and examined the ship before he left at night.

Glenbeigh, co. Kerry.

On the 2nd June an accident occurred near Glenbeigh, by which two persons were killed on the spot, and three others sustained injuries of a probably fatal character.

It appears that the five persons were picking up shells in some portion of the Artillery practice ground when they came upon an unexploded one and tried to break it open. The shell exploded with the results stated above.

The people of the district adjoining the Artillery range are in the habit of collecting old metal from exploded shells, which they sell, notwithstanding that notices are posted up warning persons against the practice.

Royal Laboratory.

An explosion of percussion caps occurred while being drummed for cleaning, in the Royal Laboratory, Woolwich, on the 24th July.

The drum in which the caps are cleaned is of sheet iron 2 feet diameter and 7 inches wide.

At the time of the explosion it was charged with about 80,000 caps for ·303 in. ball cordite ammunition (each containing 0·4 grains of special composition) together with a quantity of clean sawdust. The drum, which is turned by hand, had been revolving some three or four minutes when the explosion took place. The explosion partly blew out one side of the drum, and scorched the rope mantlet, which surrounds it to a height of 6 feet 6 inches, doing no further damage. About 20,000 caps were recovered unexploded.

Had the mantlet not been there, it is probable that the workmen in charge would have been more or less seriously injured.

This is the first explosion that has occurred while performing an operation of this character in the Royal Laboratory.

On the 30th August a second explosion occurred in the drum, the details of which were almost identical with those of the accident recorded above.

Cawsand Bay.

On the 11th October, a remarkable accident occurred at Cawsand Bay, at the entrance Plymouth Sound.

The tender to the " Defiance " Torpedo Training School was going through torpedo practice, when control was suddenly lost of the Whitehead torpedo. The missile dashed with great force against the rock, shot up 6 feet into the air, and then fell, bursting as it struck the ground. The air chamber was completely shattered, some fragments being blown to a distance of 300 yards.

Several persons narrowly escaped injury, and one man received a severe shock.

On board the " Satellite " in the Pacific.

News was received at Plymouth in October, of a gun accident on board the " Satellite " cruiser on the Pacific station.

In firing a salute the cartridge exploded, with the result that a gunner's mate had his head blown off. No fuller details of the accident, however, have been received.

Winchester Barracks.

Early on the morning of the 19th December, a fire broke out in the central block at the barracks at Winchester, by which it was stated, nearly the whole of the building was destroyed.

During the progress of the fire a small number of rounds of ball and blank ammunition for the ·303 rifle popped off one after another.

The ammunition had, it appears, been thrown loose into an iron box (similar to a cash box) in the quarter-masters' general store-room. The cartridges were, of course, of the safety pattern, and there was nothing approaching to an explosion *en masse*.

Foreign Explosions.

Foreign explosions.

Following the practice of former years, we proceed to give a brief account of the more interesting foreign explosions which have come under our notice. As we have remarked in former reports, our information as to these accidents is necessarily very incomplete, and often gleaned only from the briefest notices in newspapers.

In some instances, however, through the courtesy of the persons concerned, through the Foreign Office, or from other sources, we have been able to collect details which are interesting and often valuable.

As in former years, we are much indebted to General Abbott, of the United States army, who has furnished us with much information as to American explosions.

In the following list the countries are arranged in alphabetical order; the more trivial explosions have been omitted.

Africa.

During August several children were playing with gunpowder at their homestead—at Estcourt; they were badly burnt by the explosion which followed. The house was damaged.

America. Harlem Ship Canal.

On the 20th December 1893,* an explosion occurred at the works of the Harlem Ship Canal on the border of Spuyten Duyvil Creek, by which three men were seriously, and several others slightly injured.

The explosion occurred on the dirt scow "Catherine," which was lying in the canal, laden with refuse, stone and dirt, near a spot known as the Ledge.

The men who were injured were at work on the deck of the scow, cracking stones which had been removed from the excavations for the canal.

One of the men struck a stone; immediately there was a terrific explosion.

Fragments of rocks were scattered for a considerable distance, and the scow was swamped.

An investigation showed that the explosion was due to a dynamite cartridge which had remained imbedded in the drill hole in a large mass of rock, and had failed to explode when the blast was fired.

Nashville Penitentiary.

On the 1st January, as three coloured labourers were engaged in thawing a box of dynamite in connexion with the work of excavating for the foundation of the new state Penitentiary, an explosion occurred, and the three men were instantly killed, their bodies being mangled and torn almost to atoms.

Poughkeepsie.

On the 6th January the Laflin and Rand Powder Mill, situated about 12 miles from Poughkeepsie, New York, exploded. Four persons were killed and a large number injured. The explosion, it was stated, occurred in the "Glaze Department, where the powder is dried." Most of the buildings, about 16 in number, were completely wrecked.

The corning mill, which contained about 200 kegs of powder, was blown up almost instantly after the drying house, the flames from the first explosion shot through the open door igniting the powder.

A glazing house near the scene of the explosion, in which 16,000 lbs. of powder lay scattered about the floor, and in which three men were busy at the time, fortunately escaped.

In three store-houses less than a half mile away, 18,000 kegs of powder were stored. The buildings were damaged, but there was no explosion.

The total loss will probably exceed $25,000.

The cause of the accident was not ascertained.

Chicago.

On the 3rd February a disaster, resulting in the death of two men and the serious injury of three others, occurred through the explosion of a dynamite cartridge whilst the men were engaged in connexion with the cutting of the drainage canal near the city of Chicago.

* This accident only came to our notice whilst this year's report was in course of preparation.

One of the labourers was terribly injured and died immediately. The other (the contractor) lingered until the following day. The accident appears to have been caused by the workman's pick coming into contact with an unexploded cartridge among the débris.

Sumneytown.

On the 21st February the Dynamite Mill at Sumneytown, near Allentown, Pa., exploded with terrible effect. The buildings, all of frame, were completely demolished and reduced to splinters. One man (the only one on the premises at the time) was blown to atoms.

Repauno Chemical Works.

An explosion took place on the 2nd March, in one of the nitro-glycerine buildings of the Repauno Chemical Works at Thompson Point near Paulsborough, New Jersey, by which one man was killed and the building was blown to pieces. There were usually half-a-dozen men employed in this building, but on the day in question five of them had left the house to do work in another part of the factory. Windows were broken for miles around. This was the second explosion at this place. The first occurred nine years ago, when five persons were killed.

The cause of the explosion was not ascertained.

New York.

Two labourers were badly injured while working in a sewer at One Hundred and Fifty-sixth Street and Elton Avenue on the 5th March.

Arrangements had been made for two blasts with dynamite, and the first failed to explode. The foreman told the men to leave it alone until the following morning, when another hole should be drilled and both blasts touched off. When his back was turned the men ran the drill down the loaded hole and began to pound. The charge exploded. One man had his arm broken, and the other man had his eyes injured.

Greenspond, St. John's.

A serious dynamite explosion occurred on the 7th March on board the sealing steamer "Walrus," at Greenspond, about 70 miles north of St. John's.

The harbour being tightly frozen it was found necessary to use dynamite to break the ice so that the ships could gain open water.

Three of the "Walrus's" crew were warming dynamite in the galley when the explosion occurred. Two of the men were killed almost instantly, and the third was seriously injured. The rest of the crew, 200 men, were on the ice at the time.

The explosion also partially wrecked the ship's deck, tore up several beams, broke the foremast, shattered the bulwarks, and did serious damage to the engines.

Acme Powder Factory, Pittsburg.

On the 23rd March a dynamite explosion occurred at the works of the Acme Powder Manufacturing Company, Pittsburg, Pennsylvania.

Three men and two women were killed, and many persons were injured.

From information which we have obtained through the courtesy of Brigadier General Abbot, of the United States Engineers, it appears that the explosion originated in the packing house, and that, in the first instance, there was a bright burst of "light blue" flame, which was immediately succeeded by a very violent explosion.

"The packing house was a two storey frame building, 20 feet by 85 feet, covered "with shingles. In the west end of this building there was stored about 10,000 lbs. "of 33 per cent. dynamite, and in this same building, two men were employed in "punching the dynamite into paper shells. On the second floor two girls were "employed manufacturing the shells. All four were torn to shreds. At the time of "this explosion, the boarding house, which was a two storey six room house, located "about 150 feet from the packing house, collapsed, fatally injuring the house keeper, "who died on her road to the hospital. This explosion did considerable damage to "the storage house, which was located west of the packing house on a line of the "Allegheny Valley Railway Company, a building 20 feet by 30 feet collapsing one "side of same. The report of the explosion was comparatively light. The employés "of the Railroad Company, who were about 1,500 feet from the explosion, around the "bend of a large hill, claim that the report was not much more than an ordinary "blast of three or four cartridges. On the opposite side of the river, about one mile "from the explosion, there was considerable glass broken, but from what we can "learn, the glass broken was only of single strength. Where glass was of double "strength the same was not affected, but about two miles north of the explosion at "Springdale there was considerable stained glass broken in a church. This appeared "to be the limit of the concussion.

"The factory is located in a ravine, hills on each side about 200 feet high, and "about 250 feet wide, running to the Allegheny river, at which point the Allegheny "Valley Railroad also passes.

"At 8.25 the same morning, the incorporating house, which was located about
" 90 feet from the packing house, exploded from fire in the falling débris, which was
" put out once immediately after the first explosion, but again started over an hour
" afterwards, and the men were afraid to take the chances a second time. In this
" building at the time of the explosion there was 600 lbs. dynamite and 230 lbs.
" nitro-glycerine. The explosion of this building made more of a report than the
" exploding of the 10,000 lbs. dynamite. This building, being located in so close
" proximity to the packing house, is very good evidence that nitro-glycerine will not
" explode by concussion, but requires both heat and concussion to explode the same.

"The buildings were all of frame construction. There was considerable débris
" scattered around the grounds, but not near as much as one would expect to find
" under circumstances of this kind. The lumber was apparently consumed or torn
" into such small particles that the Company have not been able to discover same.

"In the first explosion there were three men who saw the flames, they were not over
" 300 feet from the explosion. The Superintendent, Mr. Mooney, was slightly
" injured by a flying piece of the débris, but the other two men were not injured.

Another account contained the following particulars :—" The works are situated in
" a narrow valley about 200 feet wide, on the east side of the Allegheny river, running
" in general direction at right angles to it. Black Run flows through this gorge.
" The hills on each side are about 200 feet high. The Allegheny railroad passes
" along the river bank on the same side.

"The buildings were all light wood frame structures. They consisted of (1) a small
" store shed, 20 feet by 30 feet on the line of the railroad, at the mouth of the gorge.
" One side of this was collapsed or driven in by the first explosion. . . . . .
" Its distance from the packing house, where the first explosion occurred, is about
" 600 feet, also two buildings near not materially injured.

"(2.) Going east up the gorge, was the dwelling house, about 150 feet from the
" packing house. This dwelling was razed to the ground, material broken up and
" scattered ; its site was rather lower than that of the packing house.

"(3.) The packing house, a two storey frame building, 20 feet by 85 feet.

"Stored in the west end were 10,000 lbs. of dynamite of 33 per cent. nitro-
" glycerine packed in boxes ready for shipment. Filling paper cartridge shells on the
" ground floor were two workmen, upstairs were two women making paper shells.
" Cause of explosion not known, supposed to be due to carelessness of workmen. The
" location of this packing house is in a bend of the run on its left hand side.

"(4.) On the opposite side of the run about 90 feet from the packing house,
" connected by a bridge, was the incorporating or mixing house. In it were stored
" 600 pounds of dynamite, and 600 pounds of nitro-glycerine. This building was not
" materially injured by the first explosion, neither were the explosives in it exploded at
" that time, but an hour afterwards this material exploded from fire in the fallen débris.

"(5.) Next up the gorge (east) was the boiler-house about 150 feet away from the
" packing house. This structure was crushed and a man who just escaped
" outside, was stunned.

"(6.) Still further up the gorge, 300 feet fromthe packing house was the acid house,
" where the nitro-glycerine was manufactured. The building was injured inside by
" the air-blast from first explosion, but neither the walls or roof were damaged, no
" material was exploded, and the two men there were little injured by the first
" explosion.

"(7.) A storehouse further up the gorge on higher ground was not perceptibly
" injured.

"The packing house and dwelling house were both annihilated, broken into small
" fragments and scattered. The greatest distance to which débris was thrown was
" about 1,000 feet. The most remarkable feature was the escape of the incorporating
" house from the first explosion.

"The air shock was felt from the first explosion at a distance of two miles, as
" stained window glass was broken in the church at Springdale, standing at quite an
" altitude, that far away, the direction was north, and the wind was blowing
" that way.

"Across the river in houses a mile away considerable glass was broken.

"There is no great difference of level in the location of the buildings in the
" valley."*

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* It was stated that within five years dynamite factories owned by the Acme Company, situated in the neighbourhood, have been blown up five times, and that nine persons were killed.

Four persons were injured by a dynamite explosion which occurred on the 27th March, near East Braintree, Massachusetts. The explosion took place while a man was thawing dynamite cartridges preparatory to blasting. East Braintree, Mass.

While engaged in thawing dualin in a shanty on the 2nd April, one person was killed, and another fatally injured at Lowell, Massachusetts. Lowell, Mass.

Three men were killed and eleven others more or less seriously injured by a premature explosion of giant powder and dynamite, which took place on the 7th April, at the new works of the Westinghouse Electric Company, in course of construction at Brinton Station, on the Pennsylvania Road, near Braddock. Brinton Station, Braddock, Penn.

The men were engaged in excavating for the foundation of a new electric plant. A heavy charge of giant powder was placed in the solid earth. In some unaccountable manner the charge became misplaced, and the men were called back to drill for the powder. In so doing their steel drills ignited the explosive.

Five persons were killed at Oil City, Pennsylvania, on the 4th April by an explosion of nitro-glycerine; the details, however, have not come to hand. Oil City.

Twelve persons were killed and many others were injured by an explosion which occurred, on the 8th April, at a firework manufactory at Blackford, a few miles from Petersburgh. The report of the explosion was distinctly heard in that City. A large portion of the building was shattered, and the *débris* became ignited. The flames spread rapidly to the adjoining structures, in which powder and fireworks were stored, and as each house caught fire an explosion followed, and the flames shot across the street to a large trunk factory. This, too, was destroyed, as was also an old whisky distillery adjoining. Blackford, near Petersburgh.

An explosion of dynamite occurred at the corner of Southern Avenue and Natcher Street, Mount Washington, on the 24th April, causing the death of two persons, and serious injury to another. Mount Washington.

A lad about 17 years of age was sent to bring a box of dynamite (for work in connexion with a sewer in course of construction).

The lad disobeyed instructions, however, and carried the explosive into a blacksmiths' shop. Whether he dropped the box is not known. The shop was completely demolished, and the lad was blown through the roof.

An explosion occurred early in July on board the S.S. "Queen" (on her way from Kamloops, British Columbia, to Lewis Creek) on the Thompson River. Five persons out of a total of eight on board were missing the remaining three were badly injured. It was stated that there was a quantity of dynamite on board, intended for the silver mines. Thompson River. S.S. "Queen."

Some accounts stated that the accident was due to dynamite, while other accounts stated that the boiler exploded.

The following accidents are recorded as having occurred on the 4th July:

A fire broke out at Hudson, Massachusetts, involving the destruction of 25 large buildings at a loss of half a million. The accident was attributed to fireworks. Hudson.

A fire, attributed also to fireworks, resulted in the destruction of the greater portion of the town of Honey Grove, Texas, at a loss estimated at about $200,000. Dallas.

A man was severely injured by an explosion of gunpowder at Norristown, Pennsylvania. Details of the circumstances, however, never came to hand. Norristown.

Another man was fatally injured by an explosion of gunpowder at the same place. It appears that he was carrying about a quarter of a pound of gunpowder in his pocket when a spark from some fireworks ignited it.

At Frederick, Md., a man bored into an old hole which contained a charge; he succumbed to his injuries. Frederick, Md.

There was the usual number of accidents and fires at Washington due to fireworks. Thirtieth Street is credited with one accident. Thirty-second Street with another, whilst in various other places six persons were injured. Washington.

A fire was caused at Fulton Avenue by a passer-by throwing a match among the fireworks in a shop window; damage to the amount of $25 was incurred. Baltimore.

Fireworks also are credited with causing damage and loss in 16 other places.

At Lawrence, Massachusetts, a fire, resulting from sparks from a rocket, destroyed property to the amount of $30,000. Massachusetts.

Connecticut. At New Haven, Connecticut, an explosion of fireworks occurred in one of the stores. The amount of damage done was estimated at from $100,000 to $125,000.

In addition to the above, there were six persons injured by the explosion of fireworks, five persons with powder, two persons with toy cannons, and one person with a "torpedo."

Another account gave the number of the minor casualties treated at the various hospitals of Boston as 150.

"Thanksgiving Day" therefore appears to have proved more than usually costly in 1894.

Chicago. While a detachment of Federal Artillery was moving along the Grand Boulevard in Chicago, towards Hyde Park, on the 16th July, a powder wagon exploded, killing 3 soldiers, fatally wounding one and seriously injuring three others. Seven horses were killed, and injuries were reported to several persons in the street.

Largo do Sanidad. An explosion occurred during the month of August at Largo do Sanidad, Rio Janeiro. Several wagons laden with powder exploded. The force of the explosion was terrible; 32 men were killed and many injured. The neighbouring property suffered severely, several houses being entirely demolished.

The cause of the explosion was not stated.

Brooklyn. Five boxes of "Giant torpedoes," whatever they may be, exploded on the 22nd September, in the Brooklyn freight yard of the Pennsylvania Railroad. Three men were seriously injured. Seventy-five boxes were taken to the freight yard on a truck, and the truck was backed up to a freight car, and the men began to transfer the boxes from the truck to the car. About a dozen boxes had been placed in the car when one of the workmen, with two boxes in his arms, started to step from the truck to the car. He slipped and fell, and the boxes fell on the floor of the car. One of the boxes exploded, causing four others to explode.

Ironwood, Michigan. On the 8th October, at the town of Ironwood, in Michigan, a miner attempted to thaw a half box of dynamite upon a cooking-stove. The result was a terrific explosion, the house being blown into small fragments, and the man and his three sons killed, only small portions of their remains being found. The adjoining house was also wrecked, and the occupier together with his wife and two children were injured.

Summit Joliet, Illinois. While a gang of workmen employed in the construction of a canal at Summit Joliet, Illinois, were preparing for a blasting operation, on the 22nd October, the charge exploded prematurely. Three men were blown to atoms, and three others were terribly burned.

Another explosion occurred on the 20th October at the same works, by which three workmen were killed.

Rio de Janeiro. During the month of October it was reported that a secret subterranean magazine was discovered near the English cemetery in Rio de Janeiro, in which the Brazilian insurgents at the time of the late insurrection had stored a quantity of powder, shells, and dynamite. It appears that a detachment of soldiers was sent with a cart to clear the magazine, and on its way from the barracks was followed by a crowd, attracted by curiosity to the spot. During the work of clearing, a soldier dropped one of the shells, which in bursting caused the explosion of some dynamite cartridges. Sixty persons are stated to have been killed on the spot. The cart was blown to atoms, only the tyres of the wheels being afterwards found.

Chippewa Falls, Wisconsin. On the 28th October, six tons of dynamite exploded in a magazine at Chippewa Falls, Wisconsin, causing, it was feared, the loss of one life and damage amounting to about $5,000.

It was stated that the shock was terrific and was heard for miles, and that a panic was created in the churches of Bloomer, 20 miles away. Heavy plate glass windows were shattered in many parts of the city. In the vicinity of the magazine all the trees were uprooted, and not a splinter of the building could be found.

Hendrickson's Switch. On the 1st November Mr. Hudson Maxim, President of the Pneumatic Torpedo and Construction Company, brother of Mr. Hiram Maxim, inventor of the machine gun, lost his left hand as the result of a peculiar accident at the Company's works at Hendrickson's Switch.

It appears that he was experimenting with an explosive, and he sprinkled a quantity of it on the floor of the building, at the same time retaining a small amount of the

powder in his left hand. With his right hand he struck a match, and touched the powder on the floor with it.

In some way the powder in his left hand exploded simultaneously with the flash of the powder that had been sprinkled about. His hand was torn off at the wrist.

Huntingdon, Indiana.

On the 9th November three men were killed and many others injured by an explosion of dynamite at the First Street section of the Flint Creek Sewer, which crosses the city of Huntingdon, Indiana.

Some of the 100 or more workmen that were in or around the sewer had built a fire on the bank, and were thawing a 50-lb. box of dynamite. There was a tremendous crash, and the entire city was shaken.

Every house within two blocks was damaged, and several houses were totally destroyed.

Sing Sing, New York.

On the 14th November several brick buildings were nearly ruined and one life was lost by an explosion of gunpowder in a gun store in Main Street, Sing Sing, New York.

It appears that a youth who had hired a gun to go duck shooting brought it back when he had done with it with a view to return it into store. He said it was not loaded, and to prove it aimed it at a keg of powder and pulled the trigger.

An explosion followed which set off the keg, and this blew out the front and back of the store, and three persons who happened to be in the store were enveloped in the ruins.

The flying bricks struck several persons who happened to be near, seriously injuring them.

Shortly after the first keg exploded a second one went off, and then the building took fire. Over the store were dwellings in which several persons resided; these, however, were more frightened than hurt.

On the west side of the store was the meat market and that was badly shattered. On the east side was a boot and shoe store which was wrecked. Many of the stores along the street were also damaged. The loss was estimated at about $10,000.

The youth himself was killed.

Phœnix Powder Works near Farmingdale New Jersey.

On the 19th November one of the large outhouses of the Phœnix Powder Works, near Farmingdale, New Jersey, in which was stored nearly a ton of "rifle" powder, was blown up, and the two men working therein were instantly killed and several were injured.

The works are situated about a mile east of the town, in what, several years ago, was farming land.

Until the present occasion no fatality had occurred since the works were established in 1888. One of the numerous outhouses was blown up about a year or two ago, but fortunately no one was injured.

The buildings were at least 200 yards apart, and they numbered about a dozen.

The deceased men were working in the corning mill, and they were required to wear shoes without nails and to change their clothing before proceeding to work. The powder was nearly ready to be taken to the glazing mills. Suddenly the explosion occurred and the building was wrecked.

There was nothing to show how the accident occurred.

Honduras.

On the 24th November a despatch published in the "New York Herald," from their correspondent at Tequeiqalpa, Honduras, stated that while an artillery detachment was going through gun exercise there the cannon in use burst. Many men were surrounding it at the time, and that no fewer than 22 officers and men were killed, whilst several others were injured more or less severely.

Waterbury, Conn.

On the 27th November an explosion of 120 lbs. of fulminate of mercury took place in a powder house of the Waterbury Brass Company at Waterbury, Connecticut, by which one man was blown to pieces.

The fulminate was used by the Company for the manufacture of primers (? "detonators") for cartridges and was made in a small building, situated about 1,000 feet south of the factory in a vacant lot, isolated by a bend in the Manhan River.

It was within a short distance of the centre of the city, and the explosion destroyed several thousand dollars' worth of glass including a large number of large plate-glass windows. Most of the glass in the factories of the brass company and nearly every pane of glass in the New York and New England Railroad Station was destroyed. Some other minor damage to the station was also incurred.

The deceased had left the factory to get some fulminate for the workmen, and was alone in the powder house.

The cause of the accident was not ascertained.

Ohio, Taylor's Mines.

On the 6th December a miner employed at Taylor's Mines, Ohio County, threw a wet lump of blasting powder on the fire at his home. It exploded and the flash communicated to a 25 lb. can of powder in the room. A terrific explosion followed blowing the house to atoms.

The man and his wife and five children were shockingly burned and mangled, the woman died in a few hours.

Ackmonk.

On the 9th December an explosion occurred in the new tunnel which is in course of construction at Ackmonk by the New York Public Works Department (to divert the water of Byram Lake into the Kensico Reservoir), one man was blown into fragments and another was disemboweled. At least five more received serious, and two perhaps fatal, injuries.

Forcite Powder Factory, Lake Hopatcong, New Jersey.

On the 15th December an explosion occurred at the factory of the American Forcite Manufacturing Company at Lake Hopatcong, New Jersey, by which "the receiving mill" was blown to atoms.

Two watchmen were on duty at the time and no trace of them could afterwards be found.

It was stated that this was the fifth explosion that had occurred at these works within the last three years.*

Willow grove, Pennsylvania.

On the 24th December the magazine of the Acme Torpedo Company at Willow Grove, Pennsylvania, was blown to atoms by an explosion of a large quantity of nitro-glycerine. Buildings for miles around were shaken and considerable damage was done. Every window in the town was damaged. No person, however, was seriously injured.

The explosion, it was stated, was caused by the nitro-glycerine becoming over-heated from a fire whilst thawing it.

This is the third time within two years that the magazine has been destroyed.

Ivorydale, Cincinnati.

On the 27th December a digester at the Proctor and Gamble Glycerine Works, Ivorydale, blew up. The digester was used to separate glycerine from the grease. It was 30 feet high and 4 feet wide. The force of the explosion was so great that part of the tank was sent through the roof of the building three storeys high.

Two of the employés were instantly killed.

Australia.

Melbourne.

An accident by which one person was fatally injured occurred on the 12th February at St. Albans, Melbourne, in a factory for the manufacture of an explosive called "nico." The explosive was claimed to be a "safety explosive," easily ignited but not easily exploded, being inexplosive by simple ignition, but that when it was ignited it burned very violently and gave off a great heat. There was about 60 lbs. of it in the building at the time.

It appears that the accident (which is stated to have been of the nature of a fire rather than of an explosion, and which was investigated by Mr. C. Napier Hake, Chief Inspector of Explosives at Melbourne) took place in the incorporating room in which an incorporating mill was located, and was due to the deceased improperly using a steel hammer and chisel in removing incrustations of "nico" from the mill.

The whole of the interior of the building was scorched and blackened and a large portion of the woodwork was charred.

Austria.

Bisztra.

On the 27th October a powder mill at Bisztra, in Lower Weissenburg, was totally destroyed by an explosion.

Three workmen were killed on the spot and 14 were fatally injured.

Belgium.

Wetteren, near Ghent.

On the 22nd February an explosion took place in the drying-room of a powder mill at Wetteren, near Ghent.

One workman was slightly injured.

The explosion broke several window panes in houses situated in the adjacent village.

Brussels.

An extraordinary accident happened at a menagerie at St. Giles les Bruxelles on the 5th June. A box containing some gunpowder which had been left near the entrance

* *See* Annual Report for 1893, p. 47.

by some means exploded and set fire to the clothing of a woman who was acting as money taker.

The noise of the explosion and the cries of the woman caused a panic among the people inside the menagerie, and the whole of the people, about 300 in number, made a rush for the door. In the confusion a child fell close to a cage containing some bears, and was pulled in and torn to pieces. Another child was thrown down and trampled under foot by the crowd. The flames, however, were soon extinguished.

On the 18th June an explosion occurred at 11, Rue Royale, Brussels. The house was occupied by a hatter, but certain portions of it were used as offices by a patent agency.

A thorough examination of the premises had established the fact that the explosion took place in a back room on the first floor, which was more completely wrecked than any other part of the house. All the furniture, including a very heavy oak sideboard, had been shattered to atoms, and as the floor of the room had fallen in, the compartment below was strewn with the fragments. Considerable damage had also been caused in the adjacent offices, occupied by an insurance company's agent. A large desk was blown into the street, the shop being literally in ruins. The staircase was much damaged, and on the first storey nothing was to be seen but the débris of chairs, tables, &c.

It was the opinion of experts that the explosion must have been caused by forcite, but with regard to the motive of the crime, if crime there was, opinions were divided.

It was not stated whether any persons were killed or injured. The damage caused by the explosion was estimated at 500,000 francs. Six men were arrested for publicly expressing their satisfaction at the damage done.

Beverloo Camp, Caulilie.

On the 2nd December a disastrous explosion occurred at the Caulille Forcite Factory, situated near the Beverloo Camp. The whole building, which was blown up, was reduced to atoms. Three dead bodies were recovered, and 20 workmen were injured.

Matagne-la-Grande.

An explosion occurred on the 8th May at the Dynamite Factory of Matagne-la-Grande, in Belgium, causing the death of one man. The accident occurred in a small shed used for the recovery of nitro-glycerine from waste products and from the wash water. As the only man present was killed the cause could not be ascertained with certainty; some of the nitro-glycerine was, however, contained in a galvanised iron bucket, and it is probable that the accident was due to this utensil having fallen or having been struck by some hard substance.

The quantity which exploded was about 66 lbs. Débris was projected to about 164 yards, but the explosion was not communicated to other buildings.

Canada.

Coteau du Lac.

A terrible accident, resulting in the death of three men and the serious injury of three others, occurred near Coteau du Lac, a village in Solanges County, Quebec, about 36 miles south-west of Montreal, on the 13th June. The men were engaged in blasting operations in connexion with the excavation works on the Solanges Canal, and it was stated that a charge of dynamite exploded prematurely.

Hull, Quebec.

On the 4th December an explosion of dynamite occurred by which four persons were killed and a number of others more or less seriously injured.

The accident took place on the Hull Waterworks extension, at the corner of Duke and Wall Streets, Quebec. Two boxes, each containing 40 lbs. of dynamite, exploded.

The dynamite was used for blasting purposes, and was stored in a 12-foot square frame cabin erected in the street. Within was a small tin stove with a fire in it for the purpose of thawing the explosive. The four men were standing within a short distance of the cabin when one of them discovered the place to be on fire. He rushed towards it, to extinguish the flames, and was about to open the door when the explosion took place.

China.

Shanghai.

From an account published by the "Shanghai Mercury" of the great fire which destroyed the greater part of Tungkadoo, Shanghai, on the 3rd April, it appears that the fire broke out shortly after 7 o'clock in the evening, in a small shop near the river front, and about 500 yards from the French police station. Aided by a high wind the flames spread with great rapidity, and the narrow native thoroughfares were soon blocked with thousands of people hurrying from their threatened homes and laden

with their belongings. The burning districts contained a large number of cracker shops, the ignition of which led to frequent explosions, and a large factory of these fireworks, which also stood in the midst of the district, suddenly blew up with a loud report.

About 2,000 houses were destroyed by the fire, and property estimated at a value of a million taels was destroyed. No lives were reported to have been lost, but the authorities feared that there must have been a heavy list of casualties.

France.

S.S. "Equateur." An alarming explosion occurred on board the S.S. "Equateur" on the 17th January. The vessel belonged to the Compagnie de Messageries Maritimes, and she was coming up the Gironde from Pauillac. She arrived at the roadstead at Pauillac at 11 o'clock in the morning and after the usual delay for Custom House formalities, &c., steamed slowly up the river at noon, accompanied by one of the small steamers of the Gironde and Garonne Company as tender, into which the passengers and mails were being transferred as the vessels proceeded in company.

Towards two o'clock, as the officials entered the safe room, in which postal parcels of value were deposited, and were beginning to bring them out, a formidable explosion occurred, which it was stated, shook the whole vessel from stem to stern.

The safe room was shattered, as well as the adjacent cook's galley and the steward's cabin. The bulkheads of the galley and the thick cast-iron plates of the lower deck were broken and bent, and all that portion of the between decks was left fully exposed.

Two sailors were killed on the spot, a third had his face cut to pieces, and was not expected to survive, while another was also injured, though less seriously.

The force of the concussion may be inferred from the fact that the thick plate glass over the port holes, even as far as the engine-room, some distance from the safe-room, were shivered to atoms.

There seems little doubt that the explosion was due to some high explosive, but as there appears to have been no official report forthcoming, we are not in a position to state that such was the case, or to furnish any useful details of the occurrence.

The explosion seems to have occurred just as one of the sailors, who was killed, was in the act of lifting a package containing ostrich feathers, a quantity of which were found scattered all over that part of the ship.

A number of other packets of undressed feathers were torn open, and the plumes were blown in all directions.

Honfleur. On the 10th April an explosion took place at Honfleur, in a shed used as a drying-room, at a guncotton factory situated on the outskirts of the town. About 100 lbs. of guncotton were in the shed at the time, and this exploded with a terrific report, blowing the building to pieces, shattering all the windows in the neighbourhood, and setting fire to an adjoining building. But fortunately no one was injured.

Every effort was made to prevent the flames from spreading to the shed, in which a number of guncotton cartridges were stored, and this being accomplished, the outbreak was soon subdued. The accident was attributed to spontaneous combustion.

Lyons. On the 3rd August a considerable alarm was caused at Lyons by a violent explosion, followed by a fire, at a warehouse in the Rue des Feuillants.

Several persons were injured, one so severely that he was not expected to survive, and great damage was caused to the premises. The fire was caused by the bursting of an old shell which was kept upon the chimney-piece as a memento of the Franco-Prussian War of 1870. A later account stated that the shell had been used as a paper-weight, and that the explosion was caused by the act of dropping a burning match into it, in ignorance of its true nature.

Rouen. A terrible accident was reported in the papers as having occurred at Rouen on the 5th August. Towards midnight a firework manufacturer was preparing several pyrotechnic pieces for some fêtes which were to be held the following day. He had with him an old workwoman in the manufactory, and a young man. While the woman was preparing to leave for the night a violent explosion, which set fire to the building, occurred, and she was fearfully burnt, her body being completely carbonized. Both of the men also succumbed to the injuries they received.

Germany.

An explosion occurred on the afternoon of the 9th April at a dynamite factory at Doermitz by which two persons were slightly injured. Doermitz.

It appears that one of the separators in the secondary separation decomposed and exploded. The newspapers contained an exaggerated account of the accident, in which it was stated that the acid house was totally wrecked and seven persons were injured, some of them probably fatally.

An explosion occurred in the nitrating house at the dynamite factory at Krümmel on the 3rd August and involved the final washing house. Krümmel.

At the time of the explosion the third charge (400 kilos.) was in process of being run down from the separator into the final washing house, and the fourth charge was in the nitrating apparatus, and was nearly ready to be separated. About half of the third charge had reached the final washing house when bubbles of gas were observed at the corner of the separator, giving off red fumes. The two men in the building, after having admitted air into the separator, and having set in motion the automatic mechanism for opening the escape cocks, rushed from the building and had reached a distance of about 50 paces when the explosion occurred. The nitro-glycerine which was running down into the washing house served to communicate the explosion to the latter; and in this building one workman lost his life.

There were present in the final washing house about 1,000 kilos. (2,200 lbs.) of nitro-glycerine, and in the nitrating house about 200 kilos. (440 lbs.), besides 400 kilos. in the nitrating apparatus *which were not exploded.*

The destruction caused was considerable; up to a radius of 77 yards, brickwork and roofs of buildings suffered considerably, while up to 219 yards doors and windows were torn from their frames, and roofs uplifted. Traces of great air pressure were found up to 1,094 yards.

Undoubtedly, the explosion was due to spontaneous decomposition, but the cause of such decomposition has not been ascertained. The two previous charges were made of exactly the same material and under the same conditions, and nothing abnormal was noticed with them.

Greece.

An accident occurred at Corfu in August by which seven lives were lost. It was caused by a torpedo, which, it was believed, had escaped from the British Fleet in the Mediterranean. It had been picked up and sold to a Jewish marine store dealer. Corfu.

A terrible explosion, causing great damage, occurred at a factory a few miles outside Athens on the 22nd October. Six workmen employed on the premises at the time were blown to pieces. Athens.

12,000 lbs. of powder and 9,000 lbs. of nitro-glycerine exploded, and many windows in the city were broken.

It would appear, from the fact that as Greece uses a nitro-glycerine explosive, and that as both finished powder and nitro-glycerine exploded, it was probable that service powder was manufactured at the factory.

Russia.

A Mr. T. Smith, from Whitby, was handling a common shell, a relic of the Crimean War, while ashore at Sebastopol in March, and by some means or other the shell exploded, blowing him to pieces. Sebastopol.

On the 15th June an explosion occurred in the drying-room of a smokeless powder factory at Kasan. Seven workmen were killed and the building was destroyed. Kasan.

Spain.

In our last Annual Report* we gave such details as we had been able to collect from reliable sources of the terrible explosion on the 3rd November 1893, of about 33 tons of dynamite on board the vessel "Cabo Machichaco," while lying off the quay at Santander. During the operations which were being conducted to get rid of the wreckage and of a quantity of unexploded dynamite, and exuded nitro-glycerine which lay in the wreck, another very serious explosion occurred on the 21st March, by which 15 lives were lost and further serious damage was done to the city. Santander. Explosion of dynamite and exuded nitro-glycerine in wreck of exploded vessel.

Though the courtesy of the Mersey Dock and Harbour Board, we have been favoured with a perusal of a very interesting and instructive letter from Mr. Angel B. Perez, of

* Annual Report for 1893, pp. 54, 57.

Santander, relative to the operations which were in progress at the time, and to the further steps taken to remove all remaining traces of explosive, and this letter we think it desirable to reproduce *in extenso*.

We have also received through the Foreign Office information on the same subject from the British Vice Consul at Santander, and from this communication also we make extracts.

TRANSLATION of LETTER from MR. PEREZ.

"I have the honour of replying to your favour dated the 4th of April last, to which I " have not been able to reply any sooner on account of being short of some data, " which I have not obtained until the day before yesterday.

"After the first cases of dynamite had been got out of the hull of the 'Cabo " Machichaco,' it was noticed that these had exuded a large quantity of nitro- " glycerine which had settled in the orlop and after-hold. With a special pump it was " sought to remove the explosive, and this resulted in the extraction of as much as " 1,150 kilos. fluid nitro-glycerine, but afterwards it was noticed that some congealed, " and the operations were suspended.

"A technical committee appointed by the Government studied the manner of " proceeding with them in order to rid the bay of that imminent peril, and their first " task was to ascertain the quantity which might be remaining in the vessel; for this " purpose the loss was tested which was suffered by a box of dynamite of Galzacano " make, submerged in sea water. During the first 55 hours it exuded 2,400 grammes " of nitro-glycerine; from this observation and other subsequent ones, it was inferred " that the cases which were on board the 'Machichaco' in the after-hold might have " exuded from 50 to 60 per cent. of the nitro-glycerine which they contained.

"Bearing in mind the liquid nitro-glycerine extracted, and the cases which the vessel " carried, it was possible that there were yet on board in the hull (4) four tons of nitro- " glycerine, but only a crystallized layer had been seen on the first orlop, which was 10 " or 12 meters long, 50 or 60 centimetres wide, and two or three thick; this layer ran " over the waterway on the larboard side; the remainder of the nitro-glycerine might " have fallen into the hold and thence into the bilge through a hole which existed in " the bulkhead dividing the after-hold from the engine-room; it might also have been " carried along by the currents when it was fluid, as the tide rose and fell in the after- " hold, and much more so in the engine-room, where the shell was broken. The " question was to examine the bilge and the bunkers, where it was supposed the " deposit of the explosive might be. For this purpose the cylinder was taken out, as " well as much material and pieces of iron of the engine, all for the purpose of going " down through the hatchways of the midships compartment to the bottom of the " engines and to the bilge.

"The divers brought out about 15 kilos. of nitro-glycerine from the poop orlop. " This presented clustered crystals, milky white, slightly transparent, of the shape of " pointed crystals; these dissolved in hot water, and also in a current of moist steam " without producing a detonation but preserving all their properties. In order to " make use of all the ebb tides the divers were provided with electric lamps of 25- " candle power, but on account of the water being muddy these were without result, " and they got others of 100 candles.

"In this manner the work went on until the 21st March, on which date, at eight " o'clock in the evening, a diver went down into the after-hold in order to reconnoitre; " an hour afterwards a terrible explosion took place which cost the lives of 15 " workmen and the loss of five or six of the boats lying alongside the 'Machichaco,' " engaged in the operations. The distances any articles were thrown did not exceed " 100 metres from the spot of the explosion. This might be due to the stratum of " water which was above the deposits of nitro-glycerine. Nevertheless the effects of " it were of great intensity, for the vessels close by were destroyed and from the hull " of the steamer large plates fell on to the quay; a floating crane lying alongside to " starboard was completely wrecked, and the cylinder of the chain winch was torn " from the bearings and fell with one wheel on to the quay. On the following day the " 'Machichaco's' hull was examined by divers. The after-hold was wrecked and the " engine-room was sunk, although it had suffered less than the former. It was not " possible to make sure whether all the explosive had been consumed, and in order to " explore and then proceed to its extraction it was decided to make an examination by " means of explosive charges. During the 30th and 31st of March explosions were " made of 12 to 15 kilos. of dynamite of prime quality, from stem to stern, especially " about the engine-room, with regard to which there was the most doubt; the

" cartridges were fired by electric currents, and for the purposes of proceeding to these " operations the population was moved away within a radius of 500 metres.

" The repeated discharges were carried into effect without betraying the presence " of larger quantities of explosive than their own, and it is therefore permissible to " suppose that there is not remaining in the vessel any quantity of explosive which " can present any danger for the City. And now orders are expected from the " Government to proceed to its removal."

Extract from Despatch from British Vice-Consul.

" I beg to state in reply that no one knows what occasioned the disaster, although " it is generally and most likely correctly attributed to the combustion of the loose " nitro-glycerine that had collected in some of the corners or lower parts of the " wreck.

" The divers employed by the Harbour Board of Works had just relieved those in " the pay of the owners (The Vazco Andaluz Company), and descended to continue " with the work of removing such portions of the cargo and material as would be " discovered and reached with the aid of powerful electric lights, when the explosion " took place, in a manner so sudden and extraordinary as to give rise to insinuations, " connected with the supposed presence on board of contraband of war, the proofs " of which, according to rumour, had to be destroyed at all risks. The unfortunate " divers, the only persons who could have explained the disaster, perished in it.

" A similar fatality attended the catastrophe of November 3rd, brought about by a " startling disregard and contravention of the Port Regulations by the Commandant " of Marine, and the interested concealment of the full extent and nature of the cargo " of explosives by the captain and consignee, whose deaths, with those of all the " officials present, shrouded the cause of it in impenetrable mystery. The second " explosion evidently demolished all the eruptive material that remained in the ship " after the first one, for the hull, with everything in it, including the engines, were " safely blown to pieces on the 30th ultimo by means of submarine mines, the firing " of which I witnessed with the local authorities in breathless expectation of what " might follow . . . . . .

" The removal of the débris is proceeding, and in a short time all vestiges of the " vessel will have disappeared, leaving its name to the national memory as a memento " of official remissness and of commercial greed of gain, which, dreadful to think, " brought desolation upon a flourishing city."

Compostella.

At St. James, of Compostella, a fire occurred at a firework manufactory on the 3rd August, causing several explosions, though, as far as was known, without causing any loss of life. Fears, however, were entertained of the flames spreading to an adjoining dynamite store.

Galzacano.

An explosion took place on the 9th August in a dynamite factory at Galzacano. Considerable damage was done to the buildings, but no one was injured.

Miscellaneous Accidents.

Gover Farm near Abergele, North Wales.

An accident occurred at Gover Farm, near Abergele, on the 8th January, whilst burning some rubbish, papers, &c. in the grate, resulting in severe injury to one person and slight injury to another.

Amongst the papers it appears were two ordinary grocers' bags containing a white powder, which had been left in the house by the former occupier. The first one burnt harmlessly away, but when the second bag was thrown on the fire, an explosion followed, shattering a partition, lifting the roof of a small room adjoining, and breaking the windows. The fireplace, however, was uninjured, and there was nothing in the shape of powder marks on the injured person's face, or otherwise, to indicate the nature of the substance which exploded.

Dr. Dupré, in commenting upon the case, stated " I have carefully read the further " information given, and have also inquired as to what kind of material farmers use " that might possibly cause an explosion, I find that some kinds of manures are used " consisting of a mixture of saltpetre and ground linseed, or similar cake. As a rule no " doubt the saltpetre would not be present in sufficiently large proportion to produce " an explosive, but it is quite possible that some sample of such manure may have " accidently been mixed with a larger proportion of nitre than usual, and thus have " caused the accident. It is also possible that the farmer intended to mix a small " quantity of manure himself and bought the nitre for the purpose.

" Nitre by itself is also occasionally used as a manure.

" I have been trying some experiments to ascertain whether a quantity of powdered " nitre thrown on a coal fire would produce explosive effects.

" Of course I used small quantities of nitre only, and the effect produced was slight. " Still, in one or two instances a slight explosion was produced, and I think it quite " possible, not to say probable, that if a pound or so of nitre were thrown upon a good " fire that a very smart explosion would follow.*

" This seems to me on the whole the most likely explanation of what has happened. " Of course if it can be shown that the farmer never had any such manure or any " saltpetre, this theory would fall to the ground . . . . . .

" I have tried to imitate the spots on the tin by means of gunpowder, but without " success; the gunpowder stains are always entirely different."

Spontaneous combustion of a lamp shade.

The following letter on the subject of the spontaneous combustion of a lamp shade which appeared in the " Times," of May 23rd, may be usefully reproduced here :—

" To the Editor of the Times.

" Sir,

" If you could find room in your widely circulating paper for the following " lines, they may be the means of preventing accidents similar to the one which " happened at my house on May 10th.

" On the evening of that day one of my children complained that a smell of burnt " paper was perceptible in the house. This smell had been noticed some hours " previously, but was not then traced to its source. A careful search led to the " discovery that a paper lamp shade in one of the rooms had been entirely consumed " by fire. For two days prior to the accident, the lamp, a duplex, had not been " lighted, and there had been no fire in the room. Since the morning of that day, " when the room was dusted and the shade apparently in its usual condition, no one " had entered the room. The shade was made about a year ago from so-called " crinkled tissue paper, one white and one yellow sheet, gathered together on the " upper part where it was fixed to the wire frame, and formed a considerable bunch, " spreading thence over the frame below. On examination, the yellow paper was " found to be coloured by chromate of lead, and this, no doubt, was the cause of the " accident. There can, I think, be no doubt that this was a genuine case of spontaneous " ignition, though I have not as yet been able experimentally to reproduce the " necessary conditions leading to such a result. Fortunately there were no readily " inflammable articles near or a serious fire might have resulted, the origin of which " would probably never even have been suspected. The dangerous paper is readily " recognised by setting fire to a piece of it and blowing out the flame. In the case " of ordinary paper it will be found that the glow along the burnt edge is very soon " extinguished, whereas, in the case of these chromate papers, it continues until the " whole is consumed, as is the case with ordinary touch-paper. I find that besides " the yellow paper, pale green paper also contains chromate of lead, and would, no " doubt, be equally dangerous, and possibly there are papers of other colours containing " the same material. It would be interesting to learn whether any similar case has " been observed before.

" I am, yours, &c.

" Cliftonville, Sutton, Surrey, A. Dupré.
" May 19th."

West Hartlepool.

On the 19th June a violent explosion occurred at a house in Mainsforth Terrace, West Hartlepool.

From the brief account which appeared in the newspapers, it was stated that the occupier was clearing up the rooms, and on putting an envelope into the fire a violent explosion immediately followed, and all the windows in the room were shattered. The contents of the room were wrecked, and the woman who was clearing up received severe burns through her clothes catching fire. There was nothing to show, however, the nature of the substance to which the accident was due.

North Stack Signal Station.

An accident occurred at the North Stack Signal Station, Holyhead, on the 15th August, which was represented or magnified by the newspapers into the explosion of the gunpowder magazine at that station. As a matter of fact the accident was caused by the premature and unintentional firing of the gun within the gun house, the doors and port-hole being closed. One of the gunners and two gentlemen sheltering from the rain were in the house at the time, and the gunner, not thinking

* The great Gateshead explosion of 1854, which is believed to have been due to saltpetre becoming mixed in the course of a serious fire with the carbonaceous material of the bags in which it was contained, may be usefully adverted to in this connexion.

that the gun was loaded with a 6-lb. charge of powder, put in a friction tube to show the visitors how it was fired, the consequent discharge blowing away the roof and part of the side of the building, also injuring the gunner and the visitors.

The North Stack Fog Signal Station is under the charge of the Trinity House, and is a place coming within the exemptions of section 98 of the Explosives Act, 1875.

Celluloid.

The newspapers contained various accounts from correspondents enumerating instances of accidents due to the wearing of collars made of celluloid, or of similar material.

One of them mentioned a case of a little boy whose death was caused in the following way :—

"His collar touched the flame of a candle over which he was bending. The collar "not only ignited, but blazed up like paraffin, so that the little fellow's neck was in "an instant encircled with a band of flame. The nature of the burns and the shock "to the system were so severe that he died three days afterwards."

In another case a smoker let some of the lighted tobacco fall on his collar; instantly a flame began to flash round his neck, but he was fully aware of the conditions, and promptly extinguished it before he was injured.

In another instance, an accident, similar to the latter, befel a bicyclist, and in an instant the flames surrounded his neck, and so fierce was the heat that a terrible scar was the result.

Xylonite. Accident at Homerton.

In our Annual Report for 1893* we gave the particulars of a fire which occurred on the 29th December, 1893, on the premises of the British Xylonite Company's works at Homerton, by which one life was lost.

We have this year to notice another accident, also unfortunately attended with the loss of one life, and injury to seven other persons, at the same factory, on the 14th November last.

Through the courtesy of the Chief Officer of the Public Control Department, London County Council, we have been put into possession of all the facts relating to this case, so far as he has been able to ascertain them; and the conclusion to which he has arrived, after a careful consideration, and having heard the evidence given at the inquest, is that the fire originated in the operation of sawing sheets or slabs of xylonite for the purposes of making them into various articles, such as combs, &c. Contiguous to this operation was also that of grinding and bevelling the combs, a process which creates much dust, which is drawn from the grinding wheels into hoods by means of a fan; and partly from the grinding machines, but principally from the saws, an accumulation of xylonite dust on the floors and other places is unavoidable. And it is believed that the fire was caused by some extraneous substance, possibly grit, in the xylonite, which, coming into contact with the revolving saw, created a spark which probably ignited some dust from the saw falling into the box below. Some experiments which the Chief Officer of the Public Control Department has instituted, and which furnished results corresponding with the observed progress of the accident on the occasion under notice appeared to support this view. The ground for believing the presence of some gritty substance to have been the immediate cause, is that not only had the girl who was at work at the machine been carrying on this operation without accident for five years, but the operation itself had, with other hands, been carried on for 15 years, and no accident had occurred. The company have now devised a means by which a spray of cold water will play upon the saw, and any dust will at once be shot into a receptacle containing water; and the operation of grinding, which is objectionable, not only on account of the large quantity of dust which it tends to promote, but because of the friction to which it gives rise, will be given up altogether, and a planing process substituted. It has also been suggested that each worker shall be isolated by screens, and by enlarging the space between them; and we understand that the company propose to give effect to these suggestions.

The accident, as we have stated in our report on the 1893 accident, is interesting as bearing upon the question, which has more than once come under our consideration, and which will be found discussed in our Annual Reports,† viz., whether substances which under the names of celluloid, parksine, xylonite, &c. should be treated as properly falling within the restrictive regulations of the Explosives Act.

We have hitherto held (after full and careful consideration) that sufficient grounds did not exist, in the interests of public safety, for attempting to assign a construction to the Act which would bring such substances under its controlling provisions, when

* *See* Annual Report for 1893, pages 60 and 61.

† *See* Annual Reports for 1879, p. 37; 1881, p. 55; 1882, p. 9; 1892, pp. 19, 51; 1893, p. 60.

they are being prepared solely with a view to photographic purposes, or to the manufacture of inexplosive articles, such as combs, billiard balls, &c.

The accident now under notice offers no sufficient reasons for deviating from the opinions which we have expressed, and we do not think that the material is in any way prejudiced in consequence thereof.

As we have explained elsewhere, however, we have or are taking steps to procure the proper licensing of those portions of factories in which collodion cotton is required to be stored or used in the dry state for the manufacture of this class of material and where, of course, accidents of a more formidable, if not strictly explosive, character, might occur.

Suicides.

Seven cases of suicide (five at home and two abroad) by means of explosives came under our notice during the year, this being an increase of two on the preceding year.

Arundel. In January a suicide was committed at Arundel by a local tradesman. He loaded a rusty gun-barrel which had been removed from the stock, and placing the butt end in a stove, and the other end in his mouth, sat in front of the fire until the powder exploded. Death was instantaneous.

Suicide with dynamite. Slateford. On the 21st April, a contractor committed suicide at the Caledonian Railway Inn, Slateford, Midlothian. The deceased had been drinking heavily and struck two persons who had ejected him from the public-house. The police were called in, and just as they arrived, the deceased, who was in the back premises, was heard to strike a match, and this was followed immediately by a fizzing sound. The barmaid, who knew that the deceased was in possession of explosives, held back the constables, and immediately after a violent explosion occurred. The deceased was literally blown to pieces, and the outhouses were considerably damaged. Those present had a narrow escape.

Nuneaton. On the 9th August, the wife of a quarryman, at Tuttle Hill, Nuneaton, was found dead, and terribly disfigured, having placed some explosives in her mouth, which she appears to have ignited by means of a fuze.

London. On the 18th September, a saw manufacturer in Old Street, E.C., had filled a length of gas tubing with gunpowder or other explosive, and having placed the right side of his face upon the top of the tube, exploded the other end through a small touch-hole by means of a wax vesta. The unfortunate man succumbed to his terrible injuries. It was stated that he had lost his wife three years previously, since when he had been much depressed.

Liverpool. On or about the same date a man was found dead at Liverpool with his face almost blown away, having committed suicide by firing the contents of a toy cannon into his mouth.

America. Walton, New York. On the 9th December, a young man residing at Marvin Hollow, near Walton, New York, threatened his parents that he intended to commit suicide. About 9 o'clock in the evening he left the house and proceeded to the quarry; he went into the storehouse, lit a fire, and thawed out a "stick" of dynamite and destroyed himself.

France. A suicide by dynamite is recorded from St. Brice, in the Department of the Haute-Vienne, in June. A quarryman had put a cartridge into his mouth and set fire to it. The explosion blew his head off.

Scares, Hoaxes, and False Alarms.

Monmouth. A tin can found, on the 11th January, on a tramway line, at Newport, proved, on examination, to have contained no explosive.

Glasgow. During February, a package, supposed to contain dynamite, was deposited in the letter box of the Hope Street Branch Post Office, Glasgow. The parcel, which had been handed over to the police, was described as a metal case, not unlike a small coffee canister. Both ends were closed, and attached to one end by sealing wax was a piece of string. A label attached bore a message to the effect that it came from Vaillant, and was intended to terrorize the country. It was subscribed "Anarchist." Though disposed to regard the affair as a foolish hoax, the police, knowing there were Anarchists resident in Glasgow, submitted the package for examination. It proved to be an electric battery jar.

Nottingham. Late on the night of the 27th February, what was supposed to have been an infernal machine was discovered in Nottingham. The machine consisted of an ordinary cigar box, and on examination was found to contain a clock-like arrangement, with two bottles filled with a claret coloured liquid, and wrapped in cotton wool. The box also

contained a number of pieces of broken glass and iron. The whole was evidently an elaborately prepared hoax.

Bow Street Police Station.

The alleged bomb, stated by the evening papers to have been found at the Bow Street Police Station, on the 6th March, proved, on examination, to have been a hoax. It was merely a small cubical cardboard box with a hole in the lid; and inside was a quantity of sand, cotton, and a small blank cartridge for small arms, containing a little gunpowder, and a central fire-cap.

Birmingham.

In March some alarm was caused at the works of Messrs. Ratcliffe and Sons, metal dealers, Pritchett Street, Birmingham, by the discovery of what the newspapers described as a "bomb loaded with nitro-glycerine."

The "bomb," it was stated, was picked out of a heap of scrap iron which was intended for melting down, further, that it consisted of a copper shell, weighing about 2 lbs., that it had recently been imported from Amsterdam, and that it was believed to be a hand grenade intended for use in the Franco-German war.

On examination, however, it was found to consist of a nearly spherical shell, made of gun metal, about $\frac{1}{4}$ in. in thickness, $3\frac{1}{4}$ in. in diameter, weighing when empty 1 lb. 6 oz., and of a capacity equal to half-a-pint. It "was slightly conical in shape," and at the cone end a circular hole had therein inserted a screw metal plug, and that the charge evidently consisted of gunpowder. In our last Annual Report,* we referred to an accident due to the fact that some shells partially filled with explosives had been purchased by dealers in old metal, and when one of them was placed in the furnace, an explosion occurred by which three persons were injured.

Autonomie Club, Windmill Street, London.

In March a zinc cylinder was found at the Autonomie Club, Windmill Street, Tottenham Court Road, but although it had contained gunpowder at some time or other, no importance was attached to it.

Manchester.

The newspapers contained an announcement of a "startling discovery in Manchester." On the 4th March a mysterious looking canister was found on the window-sill of the Chief Constable's house. It contained a cigar-box through which ran a number of copper wires. In addition to these there were two glass tubes about 4 in. in length, some nails, and some other articles. The wires were connected with two plates immersed in liquid, forming a small battery.

An examination showed, however, that although a slight explosion might have been caused, it would probably have been of a harmless character.

Victoria Station.

On the 5th March, a tin canister was discovered in an omnibus at Victoria Station, which, on examination, was found to contain green figs in syrup, and nothing of the nature of an explosive.

Salisbury.

In March an "infernal machine" was sent to a gentleman residing at Dinton, Wilts. The box was made of tin, about 9 inches by 4 inches by 4 inches, and in one part of the lid three percussion caps were inserted (and another cap was placed inside the box) under a label on which was written "To open this box strike here with a hammer." Within the box was a quantity of all sorts of rubbish, bits of iron, half a brick, a bottle containing some liquid not explosive, a tin box containing some soot or similar unexplosive material, a quantity of sand, and some pieces of wool and clockwork.

The whole affair was simply a silly hoax, and as the sender of it was known to the police, the matter was left in their hands to deal with.

Stonehouse, Devon.

A suspicious package was found on the passenger boat at Stonehouse, Devon, on the 21st March. It consisted of a closely soldered tin, 6 inches by 4 inches, with a partly burnt fuze projecting. It turned out to be a hoax.

Blackheath.

On the 30th March, a small square-shaped bottle, with the neck broken off, containing nails, screws, and some dark substance, with cartridge and cotton fuze inserted in the neck, but not ignited, was found at a public-house, Blackheath, Greenwich, and on examination, was found to be a hoax.

St. Paul's Cathedral.

Some suspected articles were found during the afternoon service at St. Paul's Cathedral on the 3rd April. The whole thing turned out, on examination, to be simply a hoax.

Plumstead.

A small tin box, wrapped in newspaper, was picked up, on the 18th April, by a man as he was crossing Bostal Heath, near Plumstead. Seeing inside the parcel some paper with what appeared to be the name "Bourdin" and some other French words

* Annual Report for 1893, p. 43.

upon it, he became alarmed, and handed the box to a park constable, who took it to Plumstead Police Station, and thence it was sent to Scotland Yard, where the supposed dynamite proved to be a preparation for polishing brown leather boots.

Floating Harbour, Bristol. — On the 20th April, a tin canister, of suspicious appearance, was found whilst dredging was being carried on in the floating harbour, at Bristol, and proved to be an old pattern of Holmes' Distress Flare.

Oakley Street, S.W. — On the 25th April, a parcel of cartridges was discovered in some private grounds in the S.W. District. The cartridges were of the description known as "Boxer" cartridges, for the Snider rifle. No significance was attached to the matter.

Abbey Lodge, Barking. — In May a supposed bomb was found on the door step at Abbey Lodge, Barking, and, on examination, was found to be merely a stupid hoax.

Guildhall. — On the 1st May a "bomb" was found behind a statue in the Guildhall. It consisted of gas piping, with projecting tube, percussion cap, brass wire, &c., and contained coal-dust, nails, &c.; the contrivance, in short, being an elaborate hoax.

Spring Gardens. — A tin canister, filled with rubbish of sorts, and fitted with wires and an imitation fuze, but having nothing whatever of an explosive character about it, was found at the foot of a lamp post opposite 24 Spring Gardens (Admiralty Receiving Office) on the 2nd May; it is needless to add that it was a stupid hoax.

Hyde Park. — On the 3rd May a discovery was made of a supposed infernal machine in the vicinity of the Government powder magazine in Hyde Park. It was a metal canister, containing a black substance, in which was embedded a mechanical contrivance resembling clockwork.

Greek Street, Soho. — On the 19th May an alleged infernal machine was found in Greek Street, Soho. On examination, it was found that there was nothing of an explosive character in connexion with it; and there was no reasonable doubt that it was a hoax.

East Putney Railway Station. — A glass tube was found on the 22nd May on the floor of a third-class carriage on the District Railway on arrival at East Putney Station. On examination, it proved to be a tube used in connexion with an electric circuit, and in no way connected with explosives.

Ex "Holland," from Rotterdam. — A suspicious find in the City, ex "Holland," from Rotterdam, on the 3rd June, proved, on examination, to be merely a small storage battery, with nothing of an explosive nature about it.

Guildhall. — A "bomb," consisting of a piece of gas piping, with copper wire, &c. attached, was discovered on a staircase in the Guildhall early in June. It contained rice, and was evidently a hoax.

City. — On the 14th June, a suspicious looking tin box was given to a lad in the City. The box was about 6 inches by 5 inches (stamped "made in Germany") and contained a cylindrical-shaped reservoir, about $\frac{3}{4}$ inch in depth by 4 inches in width, and this contained a liquid, which turned out to have been benzoline. There was also an alarm bell, with two small receptacles fixed to the reservoir, which had a piece of wire through the centre, to which was attached another piece of wire, having two knobs at the end. It was not, however, an "infernal machine" in the sense of having anything connected with explosives about it.

Hammersmith. — On the 19th June, a suspicious looking iron pipe was found in a railway carriage on the District Railway, Hammersmith. It consisted of an iron case, containing a bottle with some water or other liquid, and filled with plaster of Paris and a few iron screws, but nothing whatever of an explosive about it.

Mile End Road, London. — Some explosive, which was found in June, on premises at Mile End Road, was accounted for by the fact that it had been sent from Wales about three years ago for exhibition (as to its injurious qualities) at the meetings held in London in connexion with the great strike at the docks; and it was put away and forgotten until it was found when the premises were being vacated.

King William Street, E.C. — Several articles of a suspicious character were found on the 23rd June, when some carmen were removing goods from the offices of the Financial Trust Corporation, King William Street, E.C.; and, from inquiries made, they were believed to have been on the premises for years. One of the articles constituted a somewhat powerful explosive. Another consisted of an explosive which had never been licensed for manufacture in or importation into this country; and the remaining article was in no way connected

with explosives. They appear to have been seized, with other goods, by the Financial Trust Corporation for a debt; but there was nothing to show to whom they originally belonged.

In June, a supposed anarchist named Fritz Brall, was arrested at Chelsea, and charged with the felonious possession of explosive materials, &c.; amongst the articles seized on the premises were sulphuric and nitric acid, a bottle containing mercury, and a bottle which had actually contained fulminate of mercury; cartridges for small arms, and a large quantity of anarchist and revolutionary newspapers; recipes for making explosives, and a copy, in German, of Johann Most's "Scientific Revolutionary Warfare and Dynamite Guide." The case was tried at the Central Criminal Court, and the man was acquitted. Mr. Justice Grantham observed, however, that it was quite a case for thorough investigation. Chelsea.

A glass tube, similar to the one discovered at East Putney Station, was found in Threadneedle Street, in July, which, on examination, proved also to be in no way connected with explosives. Threadneedle street, London, E.C.

During the month of July, an oval copper case was found in the dust-yard at No. 16, North Wharf Road, Paddington. On examination, it proved to be a hand warmer, as is sometimes carried in a muff. It was filled with a substance consisting of crystalline acetate of sodium, which is solid when cold, but liquifies at the temperature of boiling water, dissolving in its own water of crystallization. On cooling, it first gives out heat, as water would, and when kept at rest remains liquid, even when quite cold, forming a so-called super-saturated solution. Agitation, however, induces the acetate of sodium to solidify, and the whole becomes solid, during which process the latent heat of liquidity of the sodium acetate is given off. There is, thus, a double source of heat, and the vessel remains warm much longer than it would if filled with hot water only. There was, however, nothing of a really dangerous or suspicious character about the article. London, Paddington.

A suspicious-looking iron cylinder was found at Lincoln during the month of July. It was about 8 inches in length by about 4 inches in diameter. It was probably intended for some industrial purpose, and it did not appear to be specially adapted for use as a bomb. Lincoln.

A canister, filled and fitted with a glass tube to resemble an infernal machine, was discovered in July, on the window sill of a brewer's in St. Pancras Road. On examination, it was found to be a hoax. London, St. Pancras Road.

A suspicious-looking package, found in the Boat train, at Newhaven, in July, on examination, proved to be a particular description of cement for printers' blankets. Newhaven.

During the month of August, some men in a public-house had been overheard using threats towards the Dartford Powder Mills. Dartford Powder Mills.

During the month of August an account appeared in the newspapers to the effect that an alarming rumour had gained currency at Portsmouth of the discovery of an attempt to blow up the establishment at Priddy's Hard. Gosport.

On the 30th July a workman trod on a match which ignited. The incident caused some alarm, and the officer in charge was at once summoned to the spot, which was in the covered way leading to a laboratory. In a space about 10 feet by 5 feet, were found small pieces of match-heads, some on the metals over which carriages containing powder frequently pass. These were not the "safety" matches allowed to be used in the establishment, but were the ordinary red topped ones. The authorities, however, did not attach much importance to the matter, considering it probable that the matches were placed where they were found simply for purposes of concealment.

Two workmen had recently been discharged for having matches in their possession, and it was thought that these match-heads may have been thrown away by an offender to avoid detection when searched.

The forging of a steel 12-pr. shell, which was found on Clapham Common during September, gave rise to an inquiry as to the use thereof in connection with outrages. But the probable explanation was that the article had been stolen from the Royal Arsenal or elsewhere, and was simply a case of theft. Clapham Common.

On the 26th September a large iron cylinder, roughly cast, was found in Lime Street, E.C., propped against a door. The cylinder was hollow, about 3 inches in diameter, and 24 inches long, with rounded ends. There was a plug at each end. One of the plugs had a square top, and the other was filed smooth and perforated with a hole Lime Street. E.C.

about $\frac{1}{3}$ inch in diameter. It was quite empty and weighed about 25 lbs. It was probably not intended for explosives. It may, perhaps, have been intended for use as a gas holder or as a counterpoise; but it was not readily identifiable as belonging to any known mechanical appliance. It may have been an experimental production.

Trinity College, Dublin.

On the 17th October a loud explosion was heard in the vicinity of College Street, Dublin, and immediately afterwards a piece of metal tubing 5 or 6 inches long fell on the pathway in Tara Street, Great Brunswick Street. Two soldiers who were passing at the time narrowly escaped being struck by the missile. The newspapers, of course, contained articles headed "Bomb outrage" at Trinity College, but on inquiry it transpired that the students at the College were discharging fireworks, and the article in question appears to have been discharged from the same quarter, and the affair proved to be a matter of no real significance whatever.

Surrey, Epsom.

On the 29th October, a rough piece of iron tubing, closed with iron at each end, was found in a second-class railway carriage.

The newspapers stated that much excitement was caused by the discovery of a "bomb." The article in question, however, turned out to be simply an "annealing pot," belonging to an electrical engineer, and was subsequently claimed by him.

Guildford.

A suspicious package, found in a railway carriage at Guildford, on the 31st October, proved to be a hoax.

Tamworth.

All the morning papers of Saturday the 1st December contained startling accounts, to the effect that parcels of a suspicious character had been received on the previous day, at several of the Government offices in London, and by several prominent public men and by provincial mayors and others; and that their receipt gave rise to rumours of bomb outrages.

As a matter of fact there were 24 bombs despatched from Tamworth on the 30th November, by the London and North-Western Railway and by the Midland Railway, the parcels being sent as a hoax by two young residents of Tamworth, with a view to obtaining a prize in connection with the making known or advertising a certain weekly periodical.

The bombs were very similar to the bomb which was found on the man Polti, who was recently tried and convicted at the Central Criminal Court.

They were not filled with explosive, but each was fitted with a percussion cap and a nipple, and had a spring and hammer so adapted (by means of string) that upon the parcel being opened the hammer would fall and explode the cap.*

Each bomb contained a copy of the periodical above referred to.

Proceedings were, at our suggestion, instituted by the Treasury against the offenders for breaches of the Railways Explosive Byelaws and Secretary of State's Order as to Packing, and they pleaded guilty. They were each fined 48*l.*, with the alternative of three months' imprisonment (*see* Appendix T (*a*)).

Strand, Law Courts.

A bomb, similar to the foregoing, was found outside the Law Courts on the 12th November, and at the time gave rise to a large amount of exaggerated and sensational reports in the press.

OUTRAGES AND ATTEMPTS.

Home.

Greenwich Park.

An explosion took place in Greenwich Park on the 15th February.

It occurred on a zigzag path leading up to the Observatory, and the noise of the explosion attracted the attention of some schoolboys, distant about 70 to 80 yards from the spot, and one of the park keepers, and guided, it appears, by the smoke, they ran in the direction whence the explosion had proceeded, and found on the path, in a kneeling position, and fatally injured, a man who afterwards proved to be Martial Bourdin, a Frenchman (about 26 years of age), who had been residing in England for some years, and had carried on the business of a tailor in London.

The man was alive and able to ask for assistance. He was conveyed to the Seaman's Hospital, Greenwich, where he died the same evening.

The injuries he sustained consisted chiefly in the blowing off of the left hand at the wrist, and the penetration more or less complete, of various parts of his body.

Subsequent examination and inquiries conclusively proved that at the moment of the explosion the deceased was proceeding in the direction of the Observatory,

* In one instance the cap had fired, but this had apparently taken place in transport.

that he had explosives in his left hand at the time of the explosion and that from the nature and description of the explosive, together with all the circumstances of the case, there could have been no doubt that the explosion was prematurely brought about by the deceased whilst manipulating the same for the purposes of the outrage. It is not in the public interest, nor is it necessary, that the details should be further set forth.

The coroner's jury returned a verdict to the effect that the deceased received fatal injuries from the explosion of a bomb whilst in the felonious and unlawful possession of and handling the said bomb, and died within an hour of shock and hemorrhage; and the jury also found that the said Martial Bourdin did feloniously kill himself.

Bunwell.

During the month of April an attempt was made to commit an outrage against the village church at Bunwell. Two long tubes filled with gunpowder and stones were found so placed as to threaten the stained glass windows of the building. An arrest was made of a man who had bought some fuze, and who, it appears, had some grievance against a former rector. He was tried and acquitted.

Great Yarmouth.

A "bomb," with burning fuze attached, was found on one of the windows of the Great Yarmouth Conservative Working Men's Club on April 3rd. The detective officer, who made the discovery, wrenched off the fuze and prevented an explosion. The "bomb" (or parcel) was found to contain a considerable quantity of gunpowder, nails, and scrap-iron. No clue appears to have been discovered of the perpetrator of the attempt.

Case of Farnara and Polti.

An important case in connection with the possession and intended application of explosives and materials connected therewith for felonious purposes occupied attention in the early part of the year, when a young Italian named Polti was arrested with an iron article in his possession which he had had specially manufactured, and which it was conclusively established was intended for use as a bomb or infernal machine.

Shortly afterwards, a man called Guiseppi Farnara, alias Piermonte, alias Carnot, was arrested for having conspired with Polti to procure these articles with a view to their felonious application.

Both men, who had declared themselves to be Anarchists, were tried at the Central Criminal Court by Mr. Justice Hawkins, in the early part of May, for breaches of the 3rd and 4th sections of the Explosive Substances Act, 1883. Farnara pleaded "guilty," but Polti pleaded "not guilty."

It was established to the satisfaction of the jury that Polti was in possession of the iron article above referred to, which consisted of a cylinder of iron (technically known as a "nipple") having an internal diameter of 3·45 inches and a length of 3·5 inches, and screwed along its whole length, for the reception of two cylindrical iron caps, each open at one end and tapped with a female screw; and the size of the caps was a little over 3 inches in length externally and 3·85 inches in external diameter. When the caps were screwed on the whole article measured (externally) 6·25 inches long and 4·35 inches diameter. The caps had no hole or opening in the closed ends. Polti had also given an order to another manufacturer for another iron article not dissimilar in general character from the one above described, but this article he had not actually obtained possession of; but there were found in his box at his lodgings a bottle containing 2 lbs. of concentrated sulphuric acid, which he was proved to have bought, a small paper parcel containing about 2 ounces of chlorate of potash, and another paper parcel containing about 14 ounces of a chlorate powder, the details of which it is, perhaps, inexpedient to specify, but which it may be stated was a very powerful explosive, readily ignitible by friction or percussion, or by the application of such sulphuric acid as was contained in the bottle above mentioned. Either bomb, as the articles may now be called, when charged with the above powder, would have formed a very powerful infernal machine, and proved extremely destructive to life, and, under certain conditions, to property. Circumstances were brought out at the trial which clearly showed Polti's intention in regard to the use of these materials for a purpose of this sort; and, indeed, the documents in his possession appeared to indicate pretty clearly that it was his intention to bring off an explosion on the 16th May, or about a month after the date when he was arrested. It may also be mentioned that the explosive powder was almost identical with the proportions in the receipt found in Polti's possession at the same time as the other articles.

The result of the trial, which lasted about a day and a half, was that Farnara was sentenced to 20 years' penal servitude, and Polti to 10 years' penal servitude.

Bryncethin, near Bridgend.

A daring outrage was reported as having been perpetrated on the 20th June at Bryncethin, near Bridgend, an attempt having been made to blow up the Dunraven Hotel with dynamite.

A quarryman had been drinking in a public-house the whole of the day, and when he left in the evening was somewhat quarrelsome. About midnight a severe explosion took place in the cellar of the hotel, damage to the extent of between 200*l.* and 300*l.* being done, though no one was injured. The magazine at the quarry where the prisoner worked was found to have been broken into and a quantity of dynamite and fuze extracted; footprints corresponding with the prisoner's boots were found close to the place and leading to the cottage where he lived. He was sentenced to seven years' penal servitude.

Steam Launch "Kate" off Lerwick.

On the 2nd August an explosion of a small quantity of gunpowder took place in the steam launch "Kate," off Lerwick, in Shetland. It appeared that the launch, which had recently arrived, interfered with the carrying trade of the sailing boats, and an attempt was made to disable her by inserting two tins containing gunpowder, about which some large iron nails were tied, into a recess at the end of the flues under the smoke-board while the men were at breakfast. When the pressure of the steam was raised the gunpowder exploded, but beyond the bending up of a portion of the smoke-board no damage was done. No one was in the stoke-hole at the time.

New Cross.

About 20 minutes past 10 o'clock p.m., on the 14th August, a packet which had been placed in the letter box in the shop front of the post and telegraph office at No. 177, New Cross Road, exploded with considerable noise.

The post office (which was also used as a stationer's shop) was closed at 8 o'clock p.m., and the letters were collected at 9 o'clock p.m., and under ordinary circumstances there would be no other collection until midnight.

The package which caused the explosion was sufficiently intact to admit of examination.

It measured about 4 inches by 3 inches by 2½ inches, and on it was a label bearing the words, "In memory of Ravachol, Vaillant, Henri, Bourdin, and Santo."

Its examination proved beyond doubt that the explosion was intentional and malicious. Fortunately no one was injured, but one man, who was passing at the moment the explosion occurred, complained of being struck on the face with a hard substance.

Very little damage was caused; much of the stock in the shop had been displaced by the force of the concussion, and a number of the letters were blown into the street, and were lying about on the pavement, several of them being alight.

The plate glass forming the shutter over the letter box was shattered, together with about 14 panes of glass, but no structural damage was caused.

General Post Office, London.

A large Chinese cracker was found amongst the collection of letters at the General Post Office at midnight on the 27th August. It had been collected in the Eastern District. Considerable quantities of these crackers are imported (under license) and sold as fireworks. It is not inconceivable that one of these, or one of larger size, may have been used in the New Cross outrage above mentioned. They cause a very loud report, and we are disposed to think that the damage effected at New Cross might easily have thus been accomplished.

Clanricarde Estate, Galway.

An explosion occurred on 2nd October in a house at Drummin; the occupier, however, was not residing in it at the time. On examination it appeared that the reservoir of an old tin lamp fitted with a fuze was employed to contain the explosive substance, which was evidently powder. The apparatus was placed near the fireplace of an upper room, and not far from the door. The explosion caused the roof to shake, and a crack was made along the top of the walls in the plaster where the timbers rested. The joist of the door also appeared to have slipped, for a crack in the plaster ran up for some distance from the corner. The wooden chimney-piece was merely blackened by the smoke, and some grains of powder bespattered the walls.

Generally it may be stated that the outrage (which was evidently effected for purposes of intimidation) was of an insignificant character.

Walsall.

On the 11th October a "bomb," consisting of a piece of gas tube with a lighted fuze attached, was found on the window sill of the Metropolitan Bank, Walsall. It was fitted with copper wire and contained a small quantity (about 2 ounces) of gunpowder, small bullets, and tacks, and a powder of a greenish grey colour, together with a few percussion caps.

On examination it was found to be an article of no real importance or significance, being made up largely for show and to look more formidable than it was. It might have caused personal injury to passers by, but would not have caused any appreciable damage to the building.

Doubtless the author's hope of mischief lay rather in the reports which the newspapers would be certain (very injudiciously) to devote to the subject than to the effect of an explosion of the machine itself.

Tilney Street, Mayfair.

An explosion was accomplished at No. 2, Tilney Street, Mayfair, on the 4th November, by which some damage was done to the building, and windows were broken in a few of the adjoining houses. The examination of the débris, and the collection of the various portions of the exploded article enabled us to form a perfectly definite opinion as regards the nature of the apparatus which was employed. The explosive, the details of which it is not necessary to specify beyond stating that it mainly consisted of picric acid, was contained in a bomb of the same general construction as that which was discovered in the Polti case, but rather smaller, and it was fired by means of a time fuze, of which some considerable portions were recovered. Fortunately, the perpetrator bungled in his arrangements and the result of the explosion was less formidable than it might have been, and the injury done, except immediately at the front door of the house, was, generally, of an insignificant character.

It will not serve any useful purpose, but rather the contrary, were we to attempt to set out the conclusions as to the origin and intention of the outrage, which we thought might be legitimately drawn from the examination of the débris, perhaps the part of the affair which is of most consequence, is that it points to the existence of a certain amount of malignant activity which, in more careful hands, might be productive of serious consequences.

East Rainton, Durham.

On the 15th November, about 4.50 a.m., an outrage was perpetrated at East Rainton, Durham. It appeared that two pieces of metal piping, about 2 inches bore and from 8 to 12 inches in length, filled with ordinary blasting powder, were placed one on the window sill and the other on the door step of a farmer's house, and were fired almost simultaneously, the result being that all the windows in the front of the house were broken and also two windows in the houses adjoining. The door of the house was also blown in and the house was otherwise damaged.

An arrest was made, and the prisoner admitted the offence, and also that he had placed a similar "bomb" (which fortunately did not explode) on a door-step on the 8th October previously.

The man was prosecuted and committed for trial under the Malicious Injuries to Property Act (24 & 25 Vict. c. 97. s. 9). Medical evidence having been given at his trial (on the 27th February) that he was unable to plead, he was ordered to be detained during Her Majesty's pleasure.

Northumberland.

About 3 a.m. on Sunday the 18th November, an explosion occurred in the back premises of the police station at Whittingham, Northumberland, which caused a small hole in the station yard and the breaking of a few panes of glass.

A person living in the neighbourhood, who was recently prosecuted by the police, was believed to have been the author of the outrage, and it was supposed that the intention was to create an alarm rather than to endanger life or cause serious injury to property.

Yorkshire, West Riding.

Several attempts at outrages, or suspicious cases, have been reported from the West Riding of Yorkshire, due, it is believed, to mischievous boys.

For instance, on the 27th November, a glass half-pint bottle, three parts full of coarse blasting powder, having about 18 inches of fuze attached by means of a groove cut down the side of the cork of the bottle, was found in the yard of the "Talbot" Inn at Settle, placed under a lock-up fried fish van.

Again, about three weeks previously, three ginger beer bottles, containing explosives were fired in a joiner's yard at Upper Settle, and as powder had been purchased by some lads about this time it appeared probable that the explosion was due to them.

No arrests have been made, however, but the local authorities have cautioned the vendors about selling explosives to children.

Foreign Outrages.

Foreign Outrages.

The year 1894, like the two preceding years, has been noticeable for the extraordinary number and grave character of the outrages which have been perpetrated or attempted abroad, in furtherance of either political, social, industrial, or personal objects, and of the outrages of this character those which have occurred in France have been, on the whole, the most important. Fortunately it has been found possible to arrest and execute the criminals in some cases; and the accumulating testimony to the necessity for the strengthening of the law relating to this class of crime has led to some important modifications of the law in France, Spain, and elsewhere. Still we are, however, without that united international action in which, for reasons which we have set forth in previous Reports,* the ultimate solution of this apparently increasing difficulty is we believe to be found.

The following list of these outrages or attempts makes no pretence at completeness, but it includes, we believe, the most important crimes of this character, and a considerable number of those of a minor character. The list, in any case, will sufficiently indicate the very grave and widespread existence of the temper of mind which finds vent in outrages of this dastardly character.

Africa.

Tunis.

During the month of February a bomb, with lighted fuze attached, was found in the Post Restante department of the French Post Office at Tunis. The fuze was, however, extinguished before any explosion could take place, and the infernal machine was conveyed to the office of the chief of police. It was not ascertained, however, whether the affair was a practical joke, or another attempt by Anarchists.

America.

Alabama.

During the month of June the labour disturbances in Alabama had assumed a most serious aspect. The strikers blew up three bridges by means of dynamite, and the utmost anxiety was expressed as to the ultimate result of the labour conflict.

Chicago

A house was wrecked on the 6th March by a dynamite bomb which was thrown into the hall at Chicago. The front wall was shattered by the explosion and great consternation was caused among the inmates, but no one was injured.

Chicago.

A bomb outrage was perpetrated on the 6th June, at Chicago, one of the saloons in Eighteenth Street being well nigh wrecked. It appears that the bomb was thrown from the street, exploding as it struck the floor and blowing out the entire front of the building, smashing to atoms a heavy oaken frame that divided the room, splintering the bar from end to end, and blowing the window frames entirely across the street and severely wounding two persons.

Chicago.

On the 29th July, while a train on the Chicago, Burlington, and Quincy Line was leaving the stockyards at Chicago, a man was seen to approach the engine and then to run away. Shortly afterwards a terrific explosion occurred. It was subsequently discovered that the engine had been destroyed by a bomb. The perpetrator of the outrage was arrested.

Eureka.

A bomb was exploded, on the 2nd August, under the engine of a train near Eureka, Illinois, on the St. Louis and San Francisco Railway. The engine was damaged. It was believed that the dynamite used in the manufacture of the bomb was abstracted from a carload lying in a siding, and that the object of the perpetrators of the outrage was to destroy the train and rob the express cars of their contents, which were of considerable value. The bomb was placed in position near the dynamite car.

The explosion made a hole in the ground, loosened the rails and sleepers, and tore open one side of the dynamite car, exposing tons of the explosive. Fortunately the whole mass did not blow up. If it had there is little doubt that all the passengers, numbering 183, would have been killed. The express messenger had previously exchanged shots from the car platform with a supposed robber; the messenger, however, was wounded.

Farmersburgh.

On the 4th June an attempt was made to blow up a train filled with United States troops and Indiana militia, on the Evansville and Terrehaute line, near Farmersburgh, 16 miles south of Terrehaute, Indiana. The troops, numbering upwards of 300 men, under the command of General W. J. McKee, were assisting the railway company to transport coal. A number of bombs were placed under the train but they failed to explode.

* Annual Reports for 1892, p. 52, and 1893, p. 64.

On the 17th January at Greensburg, Pennsylvania, two bombs filled with dynamite, with fuzes attached, were placed against the front door of the residence of a leading townsman. An explosion occurred and the house was completely shattered, the wife of the occupier being fatally injured. Greensburg.

A man was arrested on the 12th March at Harlem, New York, with a bundle of nine cartridges and three gaspipe bombs in his possession. He was indicted, but the result has not come under our notice. Harlem.

At Lancaster, Pennsylvania, on the 17th January, a bomb, 1 foot in length and filled with dynamite, was found lying against the foundation of a four-storey building adjoining the police station. The fuze had been lighted but had apparently gone out without causing an explosion. Lancaster, Penn.

An attempt was made on the 20th February to destroy the bridge of the Pennsylvania Railway, near the city of Lancaster, by the explosion of a bomb made out of a gaspipe and filled with dynamite. Pieces of the pipe were found imbedded in the bridge, 25 feet from where the explosion occurred. The bridge itself was not seriously damaged, but the windows and doors of several dwelling-houses near were smashed and the telegraph wires were shattered. The excitement caused by the occurrence was intensified by the fact that a bomb had been found near the same spot a few weeks previously, which did not explode. Lancaster, Penn. Railway.

About 11.30 p.m. on the 27th February a bomb was exploded in the porch of a house at Lancaster in the occupation of a doctor. The house was badly damaged by the explosion; the porch was shattered, and all the windows of the house were smashed. In the parlour, which opened on the porch, the havoc was terrible, almost everything being broken into fragments. The bomb was made out of gaspipe, and was similar in construction to the bombs discovered in the city within the previous few weeks. A man was observed standing at a gas light; suddenly the light was extinguished, and in a moment he was then seen to cross the street, light a match, and walk away. In a moment afterwards the explosion took place. One person was injured in the leg by a piece of the missile. Lancaster, Pennsylvania.

This was the third case of outrage or attempted outrage occurring within four weeks, all taking place in the heart of the city.

A dynamite outrage was perpetrated on the 28th October at a boarding-house at Laurel Run, Pennsylvania, occupied by Hungarian miners. Some persons unknown placed a number of "sticks" of dynamite beneath the building and exploded them by means of electricity. The house was completely wrecked, and three of the occupants were killed, four others receiving fatal injuries. Six other persons were seriously injured. The motive for the outrage was supposed to be robbery. Laurel Run.

Several dynamite bombs were discovered on the 11th January in Avenue D., a poor residential quarter on the eastern side of New York City, near the East River. A tenement building in the avenue was shattered by the explosion of one of the infernal machines. The explosion led to the discovery of the other bombs, which had been placed in different positions, some distance apart, but (imperfectly) connected by trains of powder with the one that exploded. New York, Avenue D.

On the 17th January a tenement building in Avenue C., New York, in which 35 persons were sleeping, had a portion of its walls shattered and the glass in the windows broken by a malicious explosion. No one was injured. New York, Avenue C.

On the 30th March a supposed bomb was found under the City Hall, New York. It had been placed in the doorway leading to the Third Precinct Police Station, which occupies a portion of the basement of the building. The bomb was safely removed. New York, City Hall.

An arrest was made at New York on the 2nd November of a man who was employed as a packer of goods for shipment, in connexion with the discovery of a large number of cartridges (description not stated) concealed in nine barrels of tallow which had been received for shipment on the "Yumuri," and which it was supposed were intended for the use of insurgents.

In commenting on the foregoing a newspaper remarked: "it is possible that "the investigation may give some hint as to how the steamship, 'City of Alexandria,' "came to be wrecked by a mysterious explosion at sea on the night of the 1st Novem- "ber 1893, causing the death of 11 of the crew, and which has so far been relegated "to conjecture. The inquiry may also explain the cause of a disastrous fire which "came near wrecking the 'Seneca,' in Havana Harbour, a short time afterwards. "No satisfactory explanation of either has yet been had."

Paterson, N. J. — A bomb, it was stated, had been found under the porch of the dwelling-house of a silk manufacturer at Paterson, New Jersey, during April. On being examined it was found to contain dynamite sufficient to wreck the building and to cause great damage to the surrounding property. The infernal machine was traced to an explosive manufactory in the city.

Pennsylvania. — During the month of April, it was reported in the newspapers that the strikers in the Pennsylvania coke region had stolen some 2,000 lbs. of dynamite from the new reservoir near Dunbar. It was believed that the act portended a renewal of the disturbances, and consequently much excitement prevailed.

Richmond, Fredericksburgh, and Potomac Railroad. — On the 12th October a passenger train on the Richmond, Fredericksburg, and Potomac Railroad, was attacked by robbers who uncoupled the engine and started it at full steam down the line. They then blew up the doors of the express car of the train with dynamite, secured their plunder, and made good their escape.

Salem. — At Salem, Ohio, on the 17th January, an attempt was made to blow up the offices of a large colliery owner who had recently had some trouble with the miners in his employment. He discovered a bomb with the fuze lighted, and at once extinguished it, thus doubtless saving the lives of himself and his clerks.

Salisbury. — In October a dynamite outrage took place in a house in the township of Salisbury, near Lancaster, Pennsylvania; the occupier of which was the owner of extensive quarries in the neighbourhood. The house, which was built of brick, had been blown up by dynamite and was entirely destroyed, and the occupier and his wife were killed, while their servant received injuries which were expected to prove fatal. The authors of the outrage, it was believed, were some discharged Italian workmen.

Toledo and Ohio Central Railway. — On the 15th May an attempt was made to blow up a passenger train on the Toledo and Ohio Central Railway, some distance south of Corning, Ohio. A loaded bomb was thrown through an open window in one of the carriages by a passenger. The fuze attached to the bomb failed to ignite, and a catastrophe was thus averted. The passenger who threw the bomb was not, however, identified.

Wellington, near Yale. — During March a house occupied by a mine superintendent at Wellington, near Yale, British Colombia, was wrecked by dynamite. The outrage is supposed to have been the work of some professional agitators from the United States, who are stated to be members of a strong trade organisation with anarchist tendencies.

Wesley City. — On the 7th June at Wesley City, Illinois, strikers attacked a mine in which some men were at work, and by means of dynamite destroyed all the winding gear, &c. This completely stopped the ventilating machinery, and it was feared that the men who were unable to escape from the mine had been suffocated.

Australia.

R. C. Church, York. — During May a dynamite outrage was perpetrated resulting in the destruction of the presbytery in connexion with the Roman Catholic church at York, a town of about 1,200 inhabitants, situated on the Avon, 78 miles east of the capital of Perth.

Three separate charges of dynamite were placed under the presbytery which adjoins the church. The residence was completely shattered, and the parish priest had a very narrow escape.

Austria.

Prague. — A bomb was discovered on the 28th February in front of a loan office in Prague. It was pear-shaped, and made of glass, and was found, on examination, to contain about 25 grammes of blasting powder encased in a layer of clay filled in with a quantity of iron nails. A fuze was attached, and had been lit, but was extinguished.

Budapest. — A bomb in the form of a tin box, containing a mixture of rough saltpetre, sulphur crystals, fine charcoal, and iron filings, saturated with petroleum, was found on 16th March at the entrance to a café at Budapest.

Przemysl. Nachod. — Two bombs of a harmless nature were found on the 4th April, one in front of the Greek Catholic, or the Ruthenian Chapter House, at Przemysl, in Galicia, and the other at Nachod, in Bohemia. The first bomb consisted of a tin case filled with gunpowder and a white substance supposed to be an explosive, placed in a wood box, which also contained hobnails, shot, and pieces of lead. A burning fuze was attached, but this was extinguished. A label was also attached to the box demanding justice for the lower clergy.

The other bomb, which was filled only with gunpowder and some scraps of iron, exploded without injury, in front of the house of a manufacturer. A dismissed workman is supposed to have been the author of the outrage.

Pilsen. A bomb explosion took place between 11 and 12 o'clock on the night of the 30th September at Pilsen, in Bohemia, at the house of a director and part proprietor of a mine at Nuerschan. The explosion was described as having been of great violence, numbers of heavy stones having been hurled to a distance from the building, and the windows in the immediate neighbourhood being all broken.

It was thought that the explosive, which was believed to have been dynamite, was introduced into the cellar through an opening left for the purpose of ventilation.

No loss of life was reported, nor did it appear that any arrests were made.

The motive was supposed to have been revenge.

Belgium.

Flenn. During the month of April a bomb was placed near the house of the principal engineer of the collieries in the coal mining district of Flenn, and the explosion caused considerable damage to the building.

The attack was believed to have been due to dissatisfaction among the miners.

Liège. On the evening of the 3rd May, a dynamite explosion occurred outside the house of a doctor in the Rue de la Paix, Liège. The doctor and his wife and also two others were injured by the explosion.

The lower part of the house was shattered, the entrance hall being much damaged, and many windows were broken in the adjoining houses.

It appears that on returning home, the doctor, who was accompanied by his wife and a friend, noticed on the doorstep the infernal machine with an ignited fuze attached. The doctor picked up the machine which immediately exploded with a loud report; he fell, his face being covered with blood. In addition to cuts about the face, he received numerous wounds about the chest, and one of his legs was also broken.

Antwerp. A box filled with gunpowder, which was placed on the gratings over the cellar of a house in the Avenue Rubens, Antwerp, was exploded on the 28th June, but no details have been received.

Hondeng-Aimeries. On the 15th November, at Hondeng-Aimeries, a town in central Belgium, a dynamite bomb was exploded in a tavern frequented by workmen. The building was completely destroyed; but few people were in it at the time, and nobody was injured. The reason for the outrage was uncertain, and no arrests appear to have been made.

France.

Paris, Rue du Havre. On the 20th January a "bomb" was discovered at the Printemps shops, behind the principal entrance on the Rue du Havre, Paris. The fuze had fortunately been extinguished before it could produce an explosion. On examination, the bomb was found to consist of an iron pot of small dimensions, containing pieces of coal, bits of steel, scraps of tin, a few nails, several buckles, part of a key, and a few small stones. The powder seems to have been composed of sulphur and saltpetre, a certain quantity of another substance being also mixed with it; but it was considered rather doubtful whether it could have exploded.

Paris, Café Terminus. About 9 p.m., on the 12th February, an Anarchist entered the café of the Terminus Hotel, at the Gare St. Lazare, Paris, the place being fairly full of people at the time, and flung a bomb in the direction of the orchestra. It struck an electric lamp in its flight, and the lamp coming down with a crash, smashed a marble table in its fall. A green flame shot up, a loud report followed, and everything became enveloped in a suffocating smoke. The scene was described as terrible. It was found that about 24 persons were more or less seriously injured.

The damage to the building was, however, slight, for beyond the fracture of the table and some chairs, the breaking of glass, a few rents in the ceiling, and scoring of the floor, there was nothing to show that anything had occurred.

The Anarchist (Emile Henry) rushed out of the door and attempted to escape. A sergeant of police, who happened to be travelling on an omnibus, seeing the man running away from the direction in which the explosion was heard, divined the situation and gave chase. The Anarchist drew a revolver and fired point blank at his pursuer. He was, however secured, but not before he had wounded the sergeant seriously.

as also a woman who happened to be passing at the time. The man was subsequently tried, and guillotined.

The sergeant (Poissin) for his gallant conduct was decorated with the Cross of the Legion of Honour.

Paris, Rue du Temple.

On the 18th February a daring attempt was made to blow up the police station of the St. Avoye Quarter of Paris, situated at No. 85, Rue du Temple. In spite of the fact that the police are always on duty in the building, an Anarchist succeeded in placing an infernal machine beneath the staircase of the police station, immediately under the room occupied by the constable on duty. Fortunately, however, it was discovered before any mischief occurred.

Gare du Nord.

A more serious discovery was made at the Gare du Nord the previous night. A tin receptacle, to which a fuze was attached, was found in the newspaper box at the station post office.

Paris, Rue St. Jacques.

An explosion occurred on the 19th February at 69, Rue St. Jacques, Paris, which was let out in furnished apartments. A man of suspicious appearance took a room in the house, and afterwards went out. As he failed to return in the evening, the door was opened, when an explosion occurred, proceeding from an infernal machine which had apparently been placed above the door. The proprietress was fatally, and two others were slightly injured. The infernal machine was stated to have been constructed from a sardine box.

Paris, Church of the Madeleine.

An explosion somewhat resembling in some of its details the one which occurred at Greenwich Park,* took place at the Church of the Madeleine, Paris, on the 15th March, at about half-past 2 or 20 minutes to 3 o'clock, resulting in the death of a noted Anarchist, Pauwells. Little damage, beyond the padded doors being torn to pieces and blown off, appears to have been done to the church.

One account, in describing the affair, states that on entering the church the man was confronted by one of the beadles, and that at the sight of the official he drew back, and retraced his steps, re-entered the "tambons," and then proceeded to the right-hand padded double doors. It is supposed that the Anarchist was placing the infernal machine between the double doors when it exploded. Other persons imagine that it exploded from a knock it received by the padded door swinging back upon it. And a third supposition is, that the individual had thought of entering the church and mixing with the people assembled there to listen to the afternoon service, but, at the last moment, fearing detection after the explosion which he knew would occur, he had hurried back in order to escape by the outer door, and in some way, perhaps by the bungling introduction of a tube containing sulphuric acid, exploded the bomb. But, in whatever manner it occurred, the body of the man lay just by the door, shockingly mutilated, and, indeed, almost blown to pieces.

The bomb itself was stated to have been one of those which explode by the mixture of chemical products on being turned upside down; and it appears to have been similar to the bombs used at the Rue St. Jacques and Faubourg St. Martin. The nails used in the machine were those used by leather dressers, and the man appears to have been a leather-dresser by trade.

Paris. Jallien.

On the 21st March a bomb with a long fuze attached was placed inside the door of the parish church of Jallien, near Grenoble. There was a large congregation in the edifice at the time, and as the smoke from the fuze spread through the building a panic ensued, and a general rush was made to the exits. Twenty persons were hurt in the stampede, three of them being almost trampled to death. Just as the church became empty the bomb exploded.

Paris. Restaurant Foyot.

On the 4th April, a bomb which had been placed in a flower box outside the Restaurant Foyot, Paris, just opposite the Senate, exploded with somewhat serious consequences. The restaurant is a house situated at the corner of the Rue Vaugirard and the Rue Condé, and it was on the left hand window next the Rue Condé that the bomb was placed. Three persons were seriously injured by the explosion. In addition, several persons sustained bruises or slight injuries. The bomb consisted of a large tin, such as is used for preserving meats, filled with pieces of metal, and containing an explosive stated to have been nitro-benzine.

For a distance of about 100 ft. around the scene of the explosion, all the windows seem to have been broken, and in a neighbouring restaurant considerable damage was done.

Paris. Boulévard Diderot.

At about a quarter to 12 o'clock a.m. on the 17th April, a bomb was thrown on the Boulévard Diderot, at the corner of the Rue Croazatier, not far from the police station.

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* *See* p. 64.

The thrower of the missile immediately took to flight. The bomb was removed to the Municipal Laboratory for examination.

A dynamite explosion occurred on the 28th April outside the Church of St. Jacques, a cartridge having been placed under a heap of stones at the corner of the building and fired by some means not stated. The windows of the adjoining houses were broken, but very little damage was done to the church. Paris, St. Jacques.

On the night of the 11th May a bomb exploded in the Avenue Kléber, the noise being heard about three miles away. Paris, Avenue Kléber.

It was found that an infernal machine had been placed in the doorway of a house occupied by a private gentleman. The bomb had burst in the doorway, rending the massive oak door from top to bottom, and demolishing the archway in which it stood. Fortunately no one was injured, but some windows were shattered. An examination made by the police disclosed the fact that a large number of missiles had been projected by the explosion, consisting chiefly of pieces of lead and large fragments of iron. No reason can be assigned for the outrage, beyond the fact that the Avenue Kléber is a very fashionable quarter of Paris, and that a number of balls and soirées were being given on the occasion in question.

In connexion with the outrage at the Café Véry, referred to in our Annual Report for 1892,* the police arrested the Anarchist Meunier during 1894, and on his extradition to France he was tried and sentenced to penal servitude for life. Paris, Café Very.

At 8 o'clock on the evening of the 22nd May an infernal machine, of which the fuze was lighted, was placed at the door of the apartment occupied by the Abbé Garnier and his brother, at No. 17, Avenue Niel. Paris, Avenue Niel.

The bomb consisted of an old petroleum can, and is said to have been charged with ordinary and chlorated powder, and weighed about 14 lbs. It was taken to the Municipal Laboratory for examination.

During the month of June a bomb was found under the windows of an apartment occupied by a police officer of Boulogne-sur-Mer, situated in the Rue Tour de France. A fuze was attached and had been lighted, but had been extinguished. An arrest was made of the author of the attempted outrage. He was a journeyman tailor who had been already prosecuted for professing Anarchist views. Boulogne-sur-Mer.

An important discovery of explosives was made during April at Aubervilliers, during the removal of some garden mould at a spot in close proximity to the Northern Railway. Among the objects found were some bombs, several bottles containing sulphuric acid, chlorate of potassium, carbonate of soda, some picric acid, and a quantity of nails and small bits of steel, several tinned-meat boxes all charged and ready for use, and a bomb of the reversible pattern, which latter appears to be of a similar type to that thrown by Vaillant in the Chamber of Deputies. The chemicals discovered are those employed in the manufacture of green powder. Aubervilliers.

It was considered fortunate that the explosives were discovered, as some of the stones, &c. were to have been carted away in a few days, and a serious accident might have occurred.

A bomb was exploded on the night of the 10th April, at the residence of M. Pelé, a justice of the peace, and the outrage appears to have been perpetrated in retaliation for the domiciliary visits which it had lately been M. Pelé's duty to make. Little injury was done, except to a summer house. Argenteuil.

A violent explosion, supposed to be the result of an Anarchist outrage, occurred at a house at Amiens, on the 3rd March. No one was injured, and it was not stated whether any damage was caused. Amiens.

During the month of March a sardine-box filled with powder, nails, and lead, was placed near the door of a dwelling at Dorat, a village in the Department of the Haute-Vienne, during some wedding festivities which were being carried on at the time. The explosion did very little damage, as the nails and lead were not scattered about; nor did the explosion attract any attention. It appears to have been intended more as a practical joke than anything else; and the practical joker stole a bowl of steaming rum punch which had been temporarily laid on a window-sill, returning the empty bowl subsequently. Dorat.

* Annual Report for 1892, p. 56.

Commune of Grand, near Espinal. On the 17th January an infernal machine containing 300 grammes of gunpowder was exploded in front of a house inhabited by the rural policeman of the commune. No damage was done.

Lourches. A dynamite explosion took place on the 3rd May at Lourches, in the Department Du Nord, outside the house of M. D. Verne, the Engineer of the Douchy Mining Company. No serious damage was done. It was believed that the outrage was an act of revenge on the part of one of the miners, and a man was arrested on suspicion.

Montpellier. A bomb was discovered at the Rue Auguste Comte, Montpellier, on 30th June It was found in a window by a passer by, but the machine, which was of a cylindrical form, failed to explode. Several arrests were made, and an inquiry was instituted.

Department du Nord. During the month of August a tin can filled with dynamite cartridges was found on a window-ledge of the residence of a foreman in the Department du Nord. Two fuzes were attached to the can, and one of them had burnt out. The police arrested a man on suspicion.

Palais de Justice, Vienne. An explosion took place on the 13th April in the courtyard of the Palais de Justice, Vienne, in the Department of the Isère. A man who was at work at the time was seriously injured. It was stated that the bomb which exploded was one recently seized in the lodgings of a local Anarchist, and that it had been put in a corner of the courtyard pending its examination by an expert.

Vioron. A bomb was exploded, on the 18th March, in the front of a tenement house at Vioron. The report was a very loud one, but no damage was done, and no one was injured. Two fragments of iron, which had evidently formed part of the bomb, were found; they were considerably shattered, and in one of them was a hole through which the fuze had apparently been passed.

Italy.

Pisa. On the 25th February there was an explosion at the Teatro Nuovo, Pisa, caused, it was at first stated, by a petard, but this was incorrect, as on examination it was found to have been merely a maroon, which was thrown through a window. No one was injured, nor was any damage done beyond the breaking of a few window panes.

Rome. An attempt was made on the 8th March to cause injury to the building in which the sittings of the Chamber of Deputies are held, in the City of Rome, by the placing of a bomb under one of the windows.

The intention of the perpetrator of the deed had certainly been to cause the explosion of the bomb at the moment when the Deputies would, under ordinary circumstances, be expected to be leaving the building. Owing, however, to the fact of Signor Crispi not being quite well, the House was adjourned at an earlier hour than usual. The bomb thus exploded after the Deputies had gone away. One man was severely injured and has since died, and six others were badly wounded.

It appears from official documents that the explosion was the result of 9 kilogrammes (19·8 lbs.) of dynamite confined in an ordinary tin petroleum case, enclosed in a solid wood box, fuzed with an ordinary detonator, and a Bickford fuze.

The ignition was probably effected by means of slow match, the rate of combustion being 90 seconds for every metre.

Pantera Theatre, Lucca. During a performance at the Pantera Theatre, at Lucca, on the night of 18th March, a gentleman who was making his way out of the building observed a tin box, with a lighted fuze attached, in a recess in one of the corridors. He immediately extinguished the fuze, and drew the attention of the attendants to the supposed bomb, of which they took charge. There were five persons arrested on suspicion, and the box was examined, the results of which, however, have not come to our knowledge.

Rome. A bomb was placed, on the 13th April, near the Coliseum. Several arrests were made, and the police had in custody a man who was arrested on the 11th April with a bomb in his possession.

A bomb exploded at the entrance to the Palace, in the Prati-di-Castello quarter of the city, on the evening of the 8th May. Three persons including the concierge, were slightly injured, but no damage was done to property.

Milan. An infernal machine, with a lighted fuze attached, was reported to have been found on a window-sill of the police head-quarters in Milan in October. No explosion occurred. Several arrests were made.

On the 20th December, the anniversary of the execution of Oberdan, two bomb explosions occurred. One of the bombs was placed at a window of the Austrian Embassy, and caused some damage to the structure, and the other near the Austrian Consulate. No loss of life or personal injury, however, resulted. Italy.

Spain.

It is satisfactory to note that measures have been taken with a view to the suppression of Anarchism in Spain.

During the month of April a Bill was introduced by the Minister of Justice.

The principal clauses of the measure may thus be summarised :—

All attempts against persons or buildings by means of explosives will be punishable by death or penal servitude for life, in all cases where the outrage has caused loss of life or personal injury.

The penalty will also be a capital or a life sentence when explosives are placed in buildings or inhabited places where they might cause injury to persons.

For cases of outrage not included in the above categories, or in which no personal injuries are caused, the punishment will be penal servitude, the term varying according to the gravity of the offence.

The same penalty is ordained against persons found in possession of explosives for which they cannot satisfactorily account, and for the sale of substances intended to be used in the manufacture of explosives with a criminal object.

The propaganda of glorification of criminal outrages, in whatever form, is made an offence punishable by severe sentences, and by the same penalties as the attempts themselves if the accused can be considered as accomplices.

Anarchist associations are declared illegal, and will be dissolved by the police, the members of such associations being liable to criminal prosecution.

In our last Annual Report* we recorded the outrage which was committed at the Liceo Theatre, Barcelona, when 22 persons were killed and a large number were injured. Barcelona.

We have now merely to record the fact that the Anarchist who threw the bomb was executed on the 21st November 1894.

On the 25th January an explosion of dynamite occurred at the Harbour Works at Barcelona, two men being killed and several others wounded. The outrage was attributed to Anarchists. Barcelona.

On the 1st January four Orsini bombs were discovered in the vicinity of Sabadell, near Barcelona, which resembled those by which the Liceo Theatre was wrecked. The Anarchists had declared that they had constructed 13 bombs of the same pattern, and some remain unaccounted for. Sabadell, near Barcelona.

On the 12th January a petard with a lighted fuze attached was found on the staircase of the Marquis d'Oliva's residence by his son-in-law. After extinguishing the fuze, the petard was examined; it consisted of an iron tube a foot in length, soldered at the ends and bound with wire. It was handed to the authorities for examination. Madrid, Marquis d'Oliva's residence.

A dynamite cartridge was exploded, on the 30th January, at the small town of Ocio. Great damage is stated to have been done to property, but no one was injured. Ocio, in the Province of Almeira.

During the month of January a bomb, with a partly burnt fuze attached, was found at the railway station at Corunna, in a passenger carriage. Corunna.

On 17th January a cylindrical shaped bomb was found at Madrid, in the gardens of the Plaza Mayor, the fuze attached to which had burned right down to the case, but without exploding the contents. Madrid.

On the 17th January a dynamite cartridge which had been placed beneath the gate of the gendarmerie barracks at Monteaqudo in the province of Soria exploded, shattering the gate and smashing several panes of glass. No one was hurt. Monteaqudo.

A dynamite cartridge was exploded at a paper manufactory at Valencia on 30th June, causing great damage to the building and machinery. Fortunately no one was injured. The author of the outrage, a workman, was arrested, and admitted that he was an Anarchist. Valencia.

A dynamite bomb was exploded, on the 12th October, outside the house of a manager of a mine at Berga, and caused considerable damage. The outrage was believed to have been the outcome of a strike among the miners. Three arrests were made. Berga.

* Annual Report for 1893, page 70.

Somozas, near Corunna.

On the 22nd October a bomb filled with dynamite exploded in a house in the village of Somozas, near Corunna. Great damage was done to property, but no loss of life or personal injury was reported.

The outrage was believed to be the result of private revenge.

Switzerland.

Constance.

On the 20th June a bomb explosion occurred in the barracks of the 114th Regiment of Infantry. The bomb consisted of a tin can charged with powder, and it was fired by means of a fuze. It had been placed in one of the cellars, and exploded just as one of the cooks was about to go down the steps. The bomb is stated to have been placed in the cellar by one of the soldiers.

Petroleum Accidents.

Following the practice of former years, we will now notice the more important petroleum accidents, repeating what we have stated on former occasions, viz., that a list of such accidents and the particulars which we are able to give necessarily make no pretence to completeness.

"Velindra."

An accident occurred on board the petroleum laden ship "Velindra,"* off Thames Haven, in the River Thames, on the 5th May, which resulted in the loss of one life and the total destruction of the barge and cargo. The circumstances were investigated by Her Majesty's Chief Inspector of Explosives, acting as an Inspector under the Merchant Shipping Acts for the Board of Trade.

From the Report it appears that the "Velindra" was a British sailing ship, built of wood in 1889. Her length was 76 feet, breadth 17 feet 6 inches, and her depth 6 feet 1 inch, and was of a tonnage of 61·98 tons.

Her forecastle was 10 feet long, and was separated from the hold by a bulkhead of 1½ inch boards.

The hold was 52 feet long and 15 feet wide.

There were two hatchways with the usual coverings and fastenings. The hold was separated from the cabin, which was aft, by a bulkhead similar to the foregoing.

There was a stove in the forecastle and another in the after-cabin, and each of them stood on stove plates, and were about 13 or 14 inches distant from their bulkheads; the portions of the latter nearest the stove were faced with iron. There was a skylight in the cabin.

Early on the morning of the 5th May the barge proceeded to Thames Haven Petroleum Wharf, and she at once commenced loading with a cargo of mineral naphtha. The crew consisted of the master, the mate, and a cook. The master's wife and child were also on board.

It was alleged that although a fire was lit in the forecastle for a short time on the morning of the 5th, it was extinguished before the vessel got alongside the wharf.

The cargo consisted of 400 barrels of "Petroleum to which the Act applies," viz., petroleum spirit, and the spirit being one which gives off an inflammable vapour at under zero, Fahrenheit.†

The barrels were generally sound and in good order, with the exception of one which was found to be leaking and some of the contents of which went into the hold. This defective barrel, however, was removed.

During the time of loading the master's wife and child were in the cabin. About two o'clock the mate went into the forecastle, and before he could re-ascend he was rendered insensible by the presence of petroleum-vapour, and had to be dragged off the forecastle ladder.

At the moment the mate was being pulled on deck a violent explosion occurred on board, and the barge was immediately in flames. The master's wife appears to have either jumped or fallen overboard in an attempt to get into a boat astern, and she was drowned. The master jumped overboard, and the cook and mate succeeded in getting on to the buoy and in rescuing the master's child; they were all subsequently rescued by a boat from the "Western Belle," a sister vessel.

The explosion was certainly due to the ignition in the cabin of the inflammable or explosive atmosphere, which had become established by the diffusion of petroleum

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* *See* Report No. 72, made by Colonel Majendie, C.B. (under the Merchant Shipping Act), to the Board of Trade.

† Mr. Redwood stated that the evaporation of between 10 and 11 volumes of this spirit (which formed the cargo of the "Velindra") into 100,000 volumes of air produces a violently explosive mixture.

vapour from the hold through the bulkhead; and it seems impossible to doubt that this ignition occurred at the fire which the master's wife had lighted in the cabin.

Atlas Works, near Pershore Railway Station.

During some experiments at the Atlas Works, Pershore, on the 25th January, with a new motor engine, an explosion occurred by which two lives were lost.

It appears from the meagre details we received, that some 2½ pints of paraffin were being used, together with some chemicals, as the ingredients of the motive power when the accident happened.

Blackburn Boiler Works.

A lad 17 years of age was employed, on the 10th March, at the Blackburn Boiler Works, as an engine tenter, and his clothing was (obviously) from the nature of his occupation saturated with oil.

The oil required for his engine was kept in a metal cistern in one corner of the paint store. This was a chamber beneath the floor of a workshop, and was lighted by means of the stair opening and a small window on a level with the footpath in the street.

The cistern being empty was, on the day in question, filled from an oil cask, and a bucketful of red varnish (a quick drying sort, which is believed to have contained mineral spirit) was also drawn from another cask. Both the oil and varnish casks stood near each other, whilst the cistern stood at the far end of the stillage. Two men were engaged in the store, and the lad had a lighted candle in his hand and was standing near the varnish cask. One of the men in ascertaining the contents of the varnish cask pulled out the bung and inserted an iron rod; directly afterwards there was an explosion and the chamber was filled with flames. Both ends of the varnish cask were blown out, the place was filled with smoke, but the building was not set on fire.

The men escaped more or less burned, but the lad, with his clothing on fire, had to be dragged out. He succumbed to his injuries on the following day.

Explosion from mineral spirit at Animal Charcoal Works, Shadwell.

An explosion occurred on the 23rd August, on the premises of the Animal Charcoal Works, 11, New Gravel Lane, Shadwell, which, from the inquiries instituted by the London County Council, and particulars of which have been obligingly furnished to this Department, appears to have been clearly due to the formation of an explosive atmosphere through the leakage of mineral spirit vapour used in the processes of manufacture.

The explosion occurred in the upper floor, in what is known as the fat extracting room, for which purpose mineral spirit is employed; and it is believed that the man who charged the extractor must have failed to securely fasten it, thus allowing a leakage of spirit vapour into the room. The man (who sustained some injury) stated that about an hour after charging the extractor he left the room for five minutes, and on returning noticed a very strong smell of petroleum. He again left the room, with a view to stopping the machinery, and very shortly afterwards the explosion occurred. It is believed that during the absence of the man the escaping vapour had passed through a door which he had left open into the room beyond, in which there was a naked gas jet. The explosion was sufficiently powerful to blow off the roof of the fat extracting room, and destroy a great portion of the walls. The corrugated iron roof was carried about 100 feet, and fell upon the roof of the sulphur house; and the whole of the buildings connected with the fat extracting and bone boiling operations were destroyed. Adjacent buildings, outside the premises, sustained injury.

The accident appears to furnish another example (if one be needed) of the necessity for maintaining observation and control over petroleum when used for manufacturing purposes.

Horton Dye Works, Bradford.

In the latter end of last year an accident occurred in one of the departments of the Horton Dye Works at Bradford, in which petroleum is employed. One of the employées was rather badly burnt by the accident, which, it was stated, was due to the vapour becoming ignited by an electric spark. The manager of the works was courteous enough to furnish us with particulars at our request, as the accident possessed features of more than ordinary interest.

It is the custom at these works to pass goods through petroleum containing paraffin wax in small quantities. The goods are then dried over steam-heated cylinders, a process which, although it has only been in operation for about two years, has been attended with three accidents.

In the present instance the machine had been running continuously for five or six hours, and the weather being close the vapours did not pass readily away.

An electric spark was observed to pass between the goods and the machine just at the moment the accident occurred. There was a good connexion between the machine and the earth, but no such connexion existed between the goods and the machine.

It appears to have been a common experience for goods on coming away from a drying machine to give quite an electric shock to the workmen engaged in removing them.

Dr. Dupré in commenting on this accident states "that it is difficult to suggest a "remedy without an exact knowledge of all the circumstances.

"In this case, however, the electric spark theory is very likely correct.

"The hot rollers and the dry cloth form a frictional electric machine, the rollers "and cloth becoming electrified by opposite electricity. The more perfect the "connexion to earth of the rollers the more electric the cloth will become, unless also "so connected. . . . . .

"The electricity should be taken from the cloth between the last larger roller and "the place where the sparking takes place. This might, perhaps, be done by placing a "number of fine wire brushes connected with earth close to both sides of the cloth. "As, however, the danger is caused by the presence of vapour, a simpler remedy "would perhaps be to box in all the rollers over which the cloth passes while "still moist with petroleum, and to ventilate this box well by a fan. The moist "cloth will produce little or no electricity, and the dry cloth would not be injured "by sparks."

After further consideration of the matter we were enabled to offer certain suggestions to the firm, which they have adopted, in the hope that a remedy may be found.

Works at Dace Road, E.

In connexion with this accident it may be useful if we draw attention to one which occurred on the 21st April 1891, on the premises of Messrs. Daintree and Company, dry cleaners, from a cause very similar to the foregoing, the account of which we gave in our Annual Report for that year.* Also in the course of a recent visit to some large waterproofing works at Dace Road, Wick Lane, Old Ford, Bow, E. (in connexion with an appeal under the Petroleum Acts), at which works large quantities of mineral spirit are employed, we learned that ignition of the vapour from the electrical discharges established by friction were at one time very common, but have now been entirely controlled by the use of suitable conductors or dischargers from the points of friction.

Fetter Lane, E.C.

A fire broke out on the premises occupied by an oil and colourman, in Fetter Lane, on the 22nd December, happily unattended with loss of life or personal injury, although, owing to the inflammable nature of the materials, the fire spread with great rapidity, and burnt fiercely. The shop was burnt out, and the upper part of the building was seriously damaged.

Foreign Petroleum Accidents.

America.

On the 14th September an oil tank on a freight train on the Chicago, St. Paul, Minneapolis, and Omaha Railway exploded at Roberts, Wisconsin. Many of the trucks caught fire, and while a number of the passengers were being conducted round the blazing cars, which caused a temporary interruption of traffic, another tank exploded.

The burning oil was scattered broadcast, and a number of persons were seriously burned.

Austria.

A serious fire broke out on the 1st September at Messrs. Wagemann's Petroleum Factory, Vienna. About 140 barrels of petroleum were destroyed. Fortunately the workmen employed on the premises were able to escape before the flames got hold of the building, and only one man was injured by burns.

The fire brigade succeeded, with the greatest difficulty, in preventing the conflagration spreading to the surrounding buildings.

The fire was believed to have originated in an explosion of a quantity of petroleum which was being subjected to the refining process.

Russia, Batoum.

A brief account appeared in the newspapers to the effect that the petroleum refinery and two kerosene reservoirs belonging to the Belgian Company at Batoum were destroyed by fire.

Russia, Przybitkovo.

A terrible accident was reported as having occurred on the 25th October at the Przybitkovo Station, on the Kosloff Vorenesh Railway. It appears that the driver of a goods train went to sleep at his post, and his train dashed into another goods train.

* Annual Report for 1891, pages 54 to 57.

The shock was tremendous, 22 trucks being piled one on the other, and broken to pieces. The train which was run into was laden with most combustible material, some trucks being filled with a large consignment of matches, while in others were carboys of benzine.

The matches caught fire, several of the carboys exploded, and the wreckage of the trains was burned to ashes. Ten railway officials who were in the two trains perished.

Russia, Grozni.

During October a statement appeared in the newspapers to the effect that the third enormous fountain of petroleum at Grozni, the site of the new naphtha fields, north of the Caucasus, had caught fire. No fewer than 17 workmen had been burnt to death; many millions of poods of naphtha are said to have been consumed, and various buildings destroyed.

Spain.

During November a brief account of a terrible occurrence in the village of Velez-Benandally, in the province of Granada, was reported by the Press.

It appears that a lamp which was in use was by some means placed close to a large tin of paraffin oil, and an explosion resulted. The shop and dwelling-house were completely wrecked. Six children, when extricated from the débris, were all found to be dead. The shopkeeper was seriously injured, and his wife, upon recovering consciousness and realizing her loss, became hopelessly mad.

VIII.

Experiments.

Experiments with percussion caps.

In consequence of the accidents which occurred at the Royal Laboratory in the course of the summer, during the drumming of some percussion caps for ·303 cordite small-arm cartridges, particulars of which are given in the accident section*, we thought it expedient to carry out some experiments with a view to determining whether it was necessary to modify the conclusion to which we had arrived as the result of former accidents and experiments, viz., that the dividing line between a "percussion cap," and a "detonator," might probably be drawn at ·5 grains of composition, *i.e.*, where the cap contained a charge of over ·5 grains of composition, it should rank as a "detonator," below that as a "percussion cap." (*See* on this subject, Annual Report for 1885, pp. 69, 117; and Annual Report for 1890, p. 53.) Of course, if the explosions in the Royal Laboratory above referred to were explosions *en masse*, there would be no doubt, seeing that these caps contained only ·4 grains apiece, that the result would seriously disturb our former conclusions; but the experiments which we have made and which are detailed in appendix Z, together with the independent observations of the officers of the Royal Laboratory (coupled with former experience), leave no reasonable doubt that the explosions in question were not explosions of caps *en masse*, but were due mainly and fundamentally to the presence among the caps in process of being drummed of a quantity of loose composition which had become detached, and to which the violence of the explosion and the fact that it included a large portion of the caps was due.

The experiments detailed in Appendix Z* appear to warrant the conclusion that caps of this character, *i.e.* containing ·4 grains of the special composition used for cordite cartridges (*see* Appendix), are not liable in their ordinary condition, and apart from any admixture therewith of loose composition, to explosion *en masse*, and, indeed, that even when the charge of this particular composition is increased to ·6 grains, such liability does not accrue. But, and this notwithstanding the fact that the caps are wide and shallow, where the caps are raised to a high temperature by the aid of artificial heat, or even still more decidedly when loose composition becomes intermixed therewith, such liability undoubtedly presents itself in a very appreciable and even formidable degree. While, therefore, we are disposed to think that in the case of caps filled with a composition containing (like those for cordite ammunition) a very low proportion of fulminate, the dividing line between a "cap" and a "detonator" may be safely raised somewhat, we consider that the experiments go to confirm the necessity for treating these caps—or indeed *any* caps—when hot as so much cap composition (measured by their contents) rather than as so many caps not liable to explode *en masse*, and still more emphatically the necessity for treating an admixture of caps and loose cap composition (whether hot or cold) as dangerously sensitive.

These last conclusions of course chiefly concern the manufacturers of these articles, as practically it is only during manufacture that such conditions could arise; but the raising of the dividing line between a cap and a detonator is important to carriers of these articles, and to persons storing them.

* See pp. 45 and 173.

We think that in future the distinction between caps and detonators may be reasonably defined as follows:—

A percussion cap to be one containing a charge not exceeding ·5 grains of composition, or ·6 grains of composition where the quantity of fulminate of mercury does not exceed one-fourth of such composition; in any other case the cap will rank as a "detonator." And we propose in future to act upon this conclusion, unless or until further experience should show the necessity for some modification. Meanwhile we shall not fail to impress upon the manufacturers the importance of dealing with caution with hot caps, or caps among which loose composition may have collected.

We have issued a circular letter to the manufacturers of percussion caps to the foregoing effect (*see* Appendix V (3)).

Experiments with uninflammable clothing.

In addition to the above, we witnessed some experiments which were carried out under the direction of the Director-General of Ordnance Factories, with a view to testing the effects of explosion of gunpowder on the fireproof clothing made of lasting cloth supplied to the workpeople of the Government danger buildings, which clothing is largely used in the private trade. Dummies dressed in suits of this clothing, both new and already used in danger building work, were placed in various positions in a house, and small bags of powder placed near them, and 100 lbs. of gunpowder was spread over the floor and fired by an electric tube. The explosion was sufficiently powerful to blow the roof off the house, but the clothing was not set fire to (except the linen "fly" of the trousers). But the front of the clothing, especially over the stomach, was considerably scorched, and it has been suggested, as a result of the experiments, which, so far as the fire-resisting qualities of the clothing go, were certainly satisfactory, that it would be an improvement to make the coats of the Norfolk jacket shape, so as to have a further covering of uninflammable clothing over the stomach in addition to the trousers. The details of this experiment (as supplied by the officers of the Department of the Director-General of Ordnance Factories) are given in Appendix Y.

Experiments on ignition of reels of cordite.

It may also be of interest and practical use to the trade, if we record the results of another experiment which we witnessed on the subject of the ignition of reels of cordite, and which were carried out by the Department of the Director-General of Ordnance Factories. The particulars are taken from a report by that officer, but we have not thought it worth while to reproduce the plan which accompanies that report:—

"On 27th February, 1894, an experiment was carried out in a house arranged for "the purpose, to ascertain the effect of a reel of cordite taking fire in a filling house, "so planned that the reels are in the same building as the workmen engaged in "filling small-arm cartridges. The house was 19 ft. 6 ins. by 12 ft. 4 ins., with a "sloping roof about 7 feet high over the reels. The reels were placed on stands, "5 ft. 9 ins. apart, the centre reel having 60 lbs. S. A. Cordite wound on it, and the "outside reel 30 lbs. each, cordite also being laid out on the tables. The reels were "protected one from the other by shelters, made of wood covered inside with "asbestos lining. Unfortunately the roof was so low that the position did not "represent sufficiently what would have occurred if a fire had broken out in one "of our own filling houses. The centre reel was fired by lighting the cordite on the "table; in two seconds it spread to the reel, in 17 seconds to reel "L," and in 22 "seconds to reel "R." The rapidity of ignition was no doubt increased by the "lowness of the roof, the flame from the centre reel being obstructed and directed "over the guard to the other reel. In a filling building this would not have occurred, "and it might have been a considerable time before the flame from one reel reached "an adjacent one. This experiment, however, has shown that unprotected reels in "a filling house are a distinct source of danger.

"In conjunction with Superintendent, Building Works Department, I am considering "a plan for better protection, and will report further."

We have the honour to be, Sir,
Your obedient Servants,

V. D. Majendie, Colonel, } Her Majesty's Chief Inspector of Explosives.

A. Ford, Colonel,
J. H. Thomson, Captain, R.A. } Her Majesty's Inspectors of Explosives.

APPENDICES to Annual Report.

APPENDIX A.

TABLE of FACTORIES,* showing the CLASSES of EXPLOSIVES authorised to be made therein.

Class and Division.	Index Numbers of Factories.	No. of Factories under Continuing Certificate.	No. of Factories under License.		Total No. of Factories.
			Licensed previous to 1894.	Licensed during 1894.	
Class 1. (Gunpowder).	1, 2, 11, 13, 15, 19, 20, 21, 23, 24, 25, 26, 29, 30, 33, 34, 37, 38, 39, 40, 42, 48, 49,† 50, 127, 143, 154.	24	3	—	27
„ „ and Class 2 (Nitrate Mixture)	53‡	1	—	—	1
Class 1 and Class 3. (Blending and packing only).	164.	—	—	1	1
Classes 1 to 4. (Packing and re-packing only)	156.	—	1	—	1
„ and Class 6. (Ammunition Division 1).	124.	—	1	—	1
Class 2. (Nitrate Mixture)	—	—	—	—	—
Class 3. (Nitro-compound). Division 1	134, 141, 148, 163	—	3	1	4
„ „ „ Divisions 1 and 2	151, 155	—	2	—	2
„ „ „ Divisions 1 and 2 and Class 6 (Ammunition)	3, 111	1	1	—	2
„ „ „ Divisions 1 and 2, Class 5 (Fulminate). Division 1, Class 6 (Ammunition) and Class 7 (Fireworks)	7	1	—	—	1
„ „ „ Division 2	14, 36, 130, 136, 142, 159	2	3	1	6
„ (Nitro-compound). Division 2, and Class 6 (Ammunition)	9, 35, 122, 135, 149	2	3	—	5
Class 4. (Chlorate Mixture). Division 1	—	—	—	—	—
„ „ „ „ 2	—	—	—	—	—
Class 5. (Fulminate). Division 1	12, 102	1	1	—	2
„ „ „ 1, and Class 6 (Ammunition) Division 1	58	—	1	—	1
„ (Fulminate). Division 1, and Class 6 (Ammunition) Divisions 1, 2, and 3	41, 114, 137	1	2	—	3
„ (Fulminate). Division 2	—	—	—	—	—
Class 6. (Ammunition). Division 1	44, 56, 61, 62, 63, 67, 69, 70, 79, 104, 107, 115, 119, 126, 132, 161.	1	14	1	16
„ Divisions 1 and 2	117, 139	—	2	—	2
„ „ „ 1, 2, and 3	46, 47, 60, 116, 133, 138, 144.	2	5	—	7
„ „ Division 2	77, 81, 88, 92, 99, 100, 101, 103, 109, 110, 113, 118, 120, 128, 140, 152, 160, 162.	—	16	2	18
„ „ Divisions 2 and 3	18, 80, 86, 95, 125, 150, 157.	1	6	—	7
„ „ and Class 7 (Fireworks)	16, 65, 73, 89, 98	1	4	—	5
Class 7. (Fireworks). Divisions 1 and 2	8, 32, 55, 57, 72, 76, 78, 84, 87, 94, 96, 121, 123, 129, 145, 147, 153, 158.	3	14	1	18
	Total	41	82	7	130

* Not including Toy Firework Factories (for number of which see Appendix B.).
† Factory 49 also by Amending License can manufacture Ammunition, Divisions 1 and 2, for experimental purposes only.
‡ Safety Blasting Powder added by Amending License.

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APPENDIX B.

TABLE of EXPLOSIVES authorised to be manufactured, with the number of FACTORIES and TOY FIREWORK FACTORIES in which each may be made.

Class and Name of Explosive.			Index Numbers of Factories.	No. of Factories in which each may be made.
Class 1.	Gunpowder		1, 2, 11, 13, 15, 19, 20, 21, 23, 24, 25, 26, 29, 30, 33, 34, 37, 38, 39, 40, 42, 48, 49, 50, 53, 127, 143, 154, 164.	29
Class 2.	Safety Blasting Powder		53	1
Class 3.	Division 1.	Amberite (No. 1)	151	1
,,	,,	Ardeer Powder	3	1
,,	,,	Ballistite	3, 155	2
,,	,,	Blasting Gelatine (Nos. 1 and 2)	3, 7, 134, 141, 148	5
,,	,,	Camphorated Gelatine	3	1
,,	,,	Carbonite	3	1
,,	,,	Carbo-dynamite	148	1
,,	,,	Dynamite (Nos. 1 and 2)	3, 7, 111, 134, 141, 148, 163	7
,,	,,	Gelatine Dynamite (Nos. 1 and 2)	3, 7, 134, 141, 148	5
,,	,,	Lithofracteur	111	1
,,	,,	Oarite	7	1
,,	,,	Primers for Gelatine	3, 148	2
,,	Division 2.	Amberite (No. 2)	151	1
,,	,,	Ammonite	142	1
,,	,,	Bellite	159	1
,,	,,	Blasting Amberite	151	1
,,	,,	Cannonite (Nos. 1 and 2)	149	1
,,	,,	Chilworth Smokeless Sporting Powder.	155	1
,,	,,	Collodion Cotton	122	1
,,	,,	Cooppal's Powder	135	1
,,	,,	Di-Flamyr	135	1
,,	,,	E. C. Sporting Powder	9, 122, 135	3
,,	,,	E. C. Powder Co's Rifle Powder, J. B. Patent.	122	1
,,	,,	Gathurst Powder	130	1
,,	,,	Guncotton	3, 7, 9, 14,* 35, 111,* 122, 135	8
,,	,,	Nitrated Guncotton	9, 14,* 111,* 122, 135	5
,,	,,	Picric Acid	136	1
,,	,,	Potentite	7, 35	2
,,	,,	Rifleite	135	1
,,	,,	Rifle Guncotton	9, 14,* 122, 135	4
,,	,,	Roburite (Nos. 1 and 2)	130	1
,,	,,	Sawdust Gunpowder	35	1
,,	,,	Sawdust and Guncotton Powder	35	1
,,	,,	Schultze Gunpowder	36, 135	2
,,	,,	Schultze Blasting Powder	36, 135	2
,,	,,	Smokeless Powder	135	1
,,	,,	Smokeless Blasting Powder	135	1
,,	,,	Tonite or Cotton Powder (Nos. 1 and 2).	7, 35, 135	3
,,	,,	Tonite or Cotton Powder (No. 3)	7	1
,,	,,	Troisdorf Powder¶	164	1
,,	,,	Walsrode Powder	155	1
Classes 1 to 4.	(Packing and re-packing only)		124, 156	2
Class 5.	Division 1.	Fulminate of Mercury	7, 12, 41, 58, 102, 114	6
Class 6.	Division 1.	Percussion Caps	41, 46, 47, 58, 114, 116, 137, 144, 161	9
,,	,,	Railway Fog Signals	7, 41, 44, 46, 47, 65, 73, 89, 104, 107, 114, 119, 137, 138.	14
,,	,,	Safety Cartridges	3, 7, 9, 16, 35, 41, 46, 47, 58, 65, 115,‖ 116, 117, 122, 124, 132, 133, 135, 137, 138, 139, 144, 149.	23
,,	,,	Safety Fuze	56, 60, 61, 62, 63,‡ 67, 69, 70, 79	9
,,	,,	Safety Firing Tubes, No. 1	7	1
,,	,,	Tube Safety Fuze	126	1
,,	Division 2.	Bickford's Patent Volley Firers	60	1
,,	,,	Cartridges for Small Arms†	9, 15, 41, 44, 46, 47, 109, 114, 116, 122, 135, 138, 149.	13

* Preparing for use only.
† Not including "rooms" used in connexion with magazines, stores, or registered premises under Section 46.
‡ Preparing gunpowder for use only in the manufacture of safety fuze.
‖ Capping of empty cartridges and miscellaneous operations connected with the manufacture of cartridge cases only.
¶ Blending and packing only.

Class and Name of Explosive.			Index Numbers of Factories.	No. of Factories in which each may be made.
Class 6.	Division 2.	Cartridges for Cannon, Blasting, &c.*	46, 47, 65, 77, 81, 88, 89, 92, 99, 100, 101, 103, 109, 110, 117, 120, 125, 128, 133, 135, 138, 139, 140, 152, 162.	25
,,	,,	Electric Fuzes	7, 18, 65, 86, 95, 111, 138, 150, 157	9
,,	,,	Electric Primers	41	1
,,	,,	Electric Tubes	80, 95, 138	3
,,	,,	Fuzes for Shells	41, 46, 47, 65, 80, 137, 138	7
,,	,,	German Spills	98	1
,,	,,	Instantaneous Fuze	60	1
,,	,,	Metallic Blasting Fuze	118	1
,,	,,	Miners' Squibs	113, 150, 160	3
,,	,,	Shells	47, 125, 138	3
,,	,,	Tubes for firing Explosives	65, 80, 138	3
,,	,,	War Rockets	65	1
,,	Division 3.	Cartridges for Small Arms†	9, 41, 46, 47, 114, 116, 135, 144	8
,,	,,	Colliery Safety Lighters	60	1
,,	,,	Detonators	7, 18, 41, 46, 137, 138	6
,,	,,	Electric Detonators	138	1
,,	,,	Electric Detonator Fuzes	7, 18, 65, 86, 95, 111, 138, 150, 157	9
,,	,,	Fuzes for Shells	41, 46, 47, 65, 80, 114	6
,,	,,	Metallic cartridges containing gunpowder.§	125	1
,,	,,	Safety Firing Tubes, No. 2	7	1
,,	,,	Tubes for firing Explosives	46, 65, 80, 138	4
,,	,,	Quick-Firing Ammunition‡	41, 46, 47, 65, 114, 133, 137, 138	8
Class 7.	Fireworks		7, 8, 16, 32, 55, 57, 65, 72, 73, 76, 78, 84, 87, 89, 94, 96, 98, 121, 123 129, 145 147, 153, 158.	24
			Toy Firework Factories, 3, 13, 14, 15, 17, 19, 20, 23, 24, 25, 26.	11

* Not including the factories in which, under Section 44, they may be made without a license, or the "workshops" used in connexion with magazines and stores under Section 47.

† Not including "rooms" used in connexion with magazines, stores, or registered premises under Section 46.

‡ For Her Majesty's Land and Sea Forces only, and in case of Factory 138 for direct exportation, or private sale, and Factories 46 and 47 for private sale.

§ For use on adjoining range only.

APPENDIX C.

TABLE of EXPLOSIVES authorised to be manufactured, with the number of FACTORIES in which each could be made at the end of each year since the passing of the Act.*

Class.	Division.	Name of Explosive.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.
1	—	Gunpowder	29	29	28	28	28	28	28	28	28	28	28	29	28	29	29	29	30	29	29
2	—	Espir's Explosive Powder.	—	—	1	1	1	1	1	1	1	1	—	—	—	—	—	—	—	—	—
		Pudrolithe	1	1	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
		Safety Blasting Powder.	—	—	—	—	—	—	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	Ardeer Powder	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1
		Amberite, No. 1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1
		Ballistite	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	2	2	2
		Blasting Gelatine (Nos. 1 and 2).	—	—	—	—	1	1	1	1	1	1	1	1	1	1	2	2	3	4	5
		Camphorated Gelatine.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1
		Carbo-dynamite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1
		Carbonite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1
		Dynamite (Nos. 1 and 2).	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	4	4	5	7
		E. C. Dynamite	—	—	—	—	—	—	—	1	1	1	1	—	—	—	—	—	—	—	—
		Gelatine Dynamite (Nos. 1 and 2).	—	—	—	—	—	—	—	1	1	1	1	1	1	1	2	2	3	4	5
		Lithofracteur	—	—	—	—	—	—	1	1	1	1	1	1	1	1	1	1	1	1	1
		Oarite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1
		Primers for Gelatine	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	2	2

* Not including two factories (124 and 156) in which packing and re-packing only of explosives of classes 1 to 4 may be carried on.

Class.	Division.	Name of Explosive.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.
3	2	Amberite No. 2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1
		Ammonite	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1
		Bellite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
		Blasting Amberite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
		Cannonite, Nos. 1 and 2.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1
		Chilworth Smokeless Sporting Powder.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
		Collodion Cotton	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
		Compressed Securite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—
		Cooppal's Powder	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1
		Cotton Gunpowder	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Denaby Powder	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—
		Di-flamyr	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1
		E.C. Sporting Powder.	—	—	—	—	—	—	1	1	2	2	2	2	2	3	3	3	3	3	3
		E.C. Sporting Powder, J.B. Patent.	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—
		E.C. Powder Co.'s Rifle Powder.	—	—	—	—	—	—	1	1	2	2	2	2	2	3	—	—	—	—	—
		E.C. Powder Co.'s Rifle Powder, J.B. Patent.	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1
		Flameless Securite	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
		Gathurst Powder	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1
		Guncotton	4	5	5	5	5	4	5	5	6	6	6	6	6	7	7	8	8	8	8
		Nitrated Guncotton	2	3	3	3	3	2	3	3	4	4	4	4	4	5	5	5	5	5	5
		Picric Acid	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1
		*Potentite	—	—	—	—	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
		Rifleite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1
		Rifle Guncotton	2	3	3	3	3	2	2	2	3	3	3	3	3	4	4	4	4	4	4
		Roburite, Nos. 1 and 2.	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1
		Sawdust and Guncotton Powder.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Sawdust Gunpowder	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Schultze Gunpowder	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
		Schultze Blasting Powder.	1	1	1	1	1	1	1	1	1		1	1	1	2	2	2	2	2	2
		Securite	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	—
		Smokeless Powder	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1
		Smokeless Blasting Powder.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1
		Tonite or Cotton Powder (Nos. 1 and 2).	1	1	1	1	1	1	1	1	1	1	1	1	2	3	3	3	3	3	3
		Tonite or Cotton Powder (No. 3).	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1
		Troisdorf Smokeless Powder.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
		Walsrode Powder	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
		Wood Gunpowder	—	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Xylobrome	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	Asphaline (Nos. 1 and 2).	—	—	—	—	—	—	1	1	1	1	1	—	—	—	—	—	—	—	—
5	1	Fulminate of Mercury.	2	2	2	2	3	3	4	5	5	5	5	5	5	5	5	6	6	6	6
6	1	Percussion Caps	6	6	6	5	5	5	5	7	7	8	8	8	8	9	10	10	9	9	9
		Railway Fog Signals	5	5	5	6	8	8	8	9	10	10	12	12	12	14	14	14	14	14	14
		Safety Cartridges	9	8	8	8	8	8	9	12	12	13	13	13	15	19	21	22	22	22	23
		Safety Firing Tubes No. 1.	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	1
		Safety Fuze	5	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
		Tube Safety Fuze	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	1
6	2	†Bickford's Patent Volley Firers.	—	—	—	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		‡Cartridges for Small Arms.	4	4	4	4	4	4	6	8	8	8	8	8	8	10	13	13	13	13	13
		§Cartridges for Cannon, Blasting, &c.	3	7	7	9	13	13	14	15	16	16	18	19	21	25	25	25	26	26	25
		Electric Fuzes	—	1	2	2	3	3	4	4	4	6	6	6	6	6	8	8	9	10	9
		Electric Primers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1
		Electric Tubes	—	—	—	1	1	2	2	2	2	2	2	2	2	2	2	2	3	3	3
		Fuzes for Shells	1	2	2	2	2	2	2	2	2	3	3	3	3	5	5	6	7	7	7
		German Spills	—	—	—	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1
		Guncotton Fuzes	—	—	1	1	—	—	—	—	—	—	—	—	—		—	—	—	—	—
		Gunpowder Fuzes	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Hunter's Patent Miners' Fuzes.	—	—	—	—	—	—	1	1	1	1	—	—	—	—	—	—	—	—	—

* First known as Liverpool Cotton Powder or Potentite.
† First known as Patent Igniters.
‡ Not including "rooms" in connexion with Magazine Stores and Registered Premises under Section 46.
§ Not including the factories in which, under Section 44, they may be made without a license, or the "Workshops" used in connexion with Magazines and Stores under Section 47.

Class.	Division.	Name of Explosive.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.
		Instantaneous Fuze	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Metallic Blasting Fuze.	—	—	—	1	1	1	—	1	1	1	1	1	1	1	1	1	1	1	1
		Miners' Squibs	—	—	—	—	—	—	1	1	1	1	1	1	1	1	1	1	2	2	3
		Shells	—	—	—	—	—	—	—	—	—	1	2	2	2	2	2	4	4	4	3
		Tubes for Firing Explosives.	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
		War Rockets	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	3	*Cartridges for Small Arms.	3	3	3	3	3	3	3	5	5	5	5	5	5	5	6	8	8	8	8
		Colliery Safety Lighters.	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	1
		Detonators	2	4	4	4	3	3	4	4	4	4	4	4	4	5	6	6	7	6	6
		Double Detonator Fuzes.	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Electric Detonators	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1
		Electric Detonator Fuzes.	—	—	2	2	2	2	3	3	3	6	6	6	6	6	8	8	9	10	9
		Fuzes for Shells	1	2	2	2	2	2	2	2	2	3	3	3	5	5	5	6	6	6	6
		†Metallic Cartridges containing Gunpowder.	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	1
		‡Quick Firing Ammunition.	—	—	—	—	—	—	—	—	—	—	—	2	6	8	8	8	8	8	8
		Safety Firing Tubes, No. 2.	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	1
		Socket Light Signals	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
		§Sound Signal Rockets	—	—	—	—	—	—	1	1	1	1	1	1	1	1	1	1	—	—	—
		§Sound Socket Signals	—	—	—	—	1	1	1	1	1	1	1	1	1	—	—	—	—	—	—
		Tubes for Firing Explosives.	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
7	—	Fireworks	12	18	20	24	25	22	25	24	24	25	25	23	24	24	24	25	26	24	24
		Toy Fireworks	—	—	9	14	15	14	13	13	13	13	16	13	12	12	12	10	11	11	11

* Not including "rooms" used in connexion with Magazines, Stores, and Registered Premises under Section 46.
† For use on an adjoining range only.
‡ For Her Majesty's Land and Sea Forces; extended to private sale and direct exportation in the case of Factory No. 138, and to private sale in the case of Factories 46 and 47.
§ Now Class 7, Division 2.

APPENDIX D (1).

The following explosives are at present authorised for manufacture in or importation into the United Kingdom.

Where the definition is derived from the Act a reference is given in italics to the section of the Act or to the Order in Council containing such definition. When no such reference appears the definition is quoted from a current license (whether for manufacture or importation) affecting that explosive. For the factories in which the various explosives may be manufactured *see* Appendix B., and for importation licenses for the various explosives *see* Appendix K.

Class 1.—Gunpowder.

Gunpowder, ordinarily so-called. *O. in C., No.* 1.

Class 2.—Nitrate Mixture.

Chilworth Special Powder, consisting of a mechanical mixture of nitrate of potassium, nitrate of ammonium, and charcoal, with or without the addition of sulphur.

Fortis Explosive, consisting of a mixture of two or more of the following substances, viz., tan, lampblack, and sulphur, such mixture being thoroughly impregnated with a mixture of nitrate of potassium and proto-sulphate of iron, and with or without the addition to such impregnated mixture of glycerine.*

Safety Blasting Powder,† consisting of a mechanical mixture of saltpetre, sulphur, lampblack, sawdust, and sulphate of iron.

Westfalite, consisting of neutral nitrate of ammonium and gum-lac, soluble in alcohol.

* This explosive is authorised for importation and issue only in the form of compressed cartridges, such cartridges being rendered thoroughly waterproof (*a*) by waterproofing the naked compressed cartridges, and (*b*) by enclosing such waterproofed compressed cartridges in a thoroughly waterproof cartridge case.

† Manufacture suspended.

Class 3.—Nitro-Compound.

Division 1.

Amberite No. 1,* consisting of thoroughly purified nitro-cellulose mixed or combined with the following substances :—

Thoroughly purified nitro-glycerine.
Paraffin free from mineral acid.
Shellac.

The whole to be of such character and consistency as not to be liable to liquefaction or exudation.

Ardeer Powder, consisting of dynamite No. 1, as herein defined, mixed or incorporated with sulphate of magnesium, with or without the addition of nitrate of potassium, nitrate of sodium, nitrate of barium, or such other nitrates as may from time to time be approved by a Secretary of State.

Ballistite, consisting of nitro-cotton†, carefully washed and purified, combined with thoroughly purified nitro-glycerine, with or without the addition of camphor, aniline, and such other substance, and solvent (if any) as may from time to time be approved by a Secretary of State§, and with or without carbonate of calcium or carbonate of magnesium, not exceeding 1 part by weight in every 100 parts by weight of the finished explosive, the whole to be of such character and consistency as not to be liable to liquefaction or exudation.

Blasting Gelatine No. 1, consisting of nitro-cotton,† carefully washed and purified, combined with thoroughly purified nitro-glycerine in such proportions that the whole shall be of such character and consistency as not to be liable to liquefaction or exudation, and with or without carbonate of calcium or carbonate of magnesium not exceeding 1 part by weight in every 100 parts by weight of the finished explosive.

Blasting Gelatine No. 2, consisting of blasting gelatine No. 1 as above defined, mixed or incorporated with nitrate of potash (with or without charcoal), or such other nitrate as may for the time being be sanctioned by a Secretary of State.

Blasting Matagnite, consisting of nitro-cellulose, carefully washed and purified, combined with thoroughly purified nitro-glycerine, and thoroughly purified nitro-benzol, or either of them, in such proportions that the whole shall be of such character and consistency as not to be liable to liquefaction or exudation.

Camphcrated Gelatine, consisting of blasting gelatine, No. 1, as above defined, mixed or incorporated with camphor.

Carbo-Dynamite, consisting of not more than 90 parts by weight of thoroughly purified nitro-glycerine, uniformly mixed with 10 parts by weight of charcoal sufficiently absorbent in quality when mixed in the above proportions to prevent exudation of the nitro-glycerine ; whether with or without the addition of one or more of the following substances, viz., nitrate of potassium, nitrate of barium, carbonate of sodium, and carbonate of ammonium, provided that the proportion of carbonate present shall not exceed 1½ parts by weight in every 100 parts by weight of the finished explosive.

Carbonite, consisting of not more than 27 parts by weight of thoroughly purified nitro-glycerine (with or without the addition of not more than half a part of sulphuretted benzol), uniformly mixed with not less than 73 parts by weight of a pulverized preparation consisting of wood meal, not less than 40 parts ; nitrates of potassium, barium and sodium (or either of them) not more than 36 parts ; and carbonates of sodium and lime (or either of them), not more than half a part, such preparation to be sufficiently absorbent when mixed in the above proportions to prevent exudation of nitro-glycerine.

Cordite,‡ consisting of thoroughly purified guncotton (as herein-after defined), mixed and incorporated with thoroughly purified nitro-glycerine and mineral jelly free from acid by means of acetone or such other solvent as may from time to time be approved by a Secretary of State, the whole to be of such character and consistency as not to be liable to liquefaction or exudation :—

Guncotton, consisting of thoroughly purified nitro-cotton (*a*), of which not more than 15 per cent. is soluble in ether alcohol, or (*b*) which contains more than 12·3 per cent. of nitrogen ; and with or without carbonate of calcium.

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* For Amberite No. 2 and Blasting Amberite, see p. 88.

† The substitution of nitro-cotton for nitro-cellulose has been effected by a Factory Amending License whilst this report was in the press.

‡ Although no license for cordite has been granted up to the end of 1894 applications for such licenses have been received, and in one instance at least the license has made such progress as to render it certain that the material will find a place on the licensed list before this report is in print. It has, therefore, been thought well so far to anticipate matters as to include cordite among the licensed explosives.

§ Up to the present time the following substances have been so sanctioned for addition to Ballistite, viz. :—
Graphite and Paraffin.
Mineral jelly.

Dynamite No. 1, consisting of not more than 75 parts by weight of thoroughly purified nitro-glycerine, uniformly mixed with 25 parts by weight of—

(*a*) An infusorial earth, known as "kieselguhr," or

(*b*) A non-explosive mixture of kieselguhr with such other ingredients and in such proportions as may for the time being be sanctioned by a Secretary of State;*

Provided:—

(1.) That the said (*a*) kieselguhr, *or* (*b*) non-explosive mixture, shall be sufficiently absorbent in quality when mixed in the above proportions to prevent exudation of nitro-glycerine; and

(2.) That there may be added to the kieselguhr or non-explosive mixture an amount of carbonate of ammonium not exceeding 1½ parts by weight in every 100 parts by weight of the finished dynamite.

Dynamite No. 2, consisting of not more than 18 parts by weight of thoroughly purified nitro-glycerine, uniformly mixed with 82 parts by weight of a pulverized preparation, composed of nitrate of potash 71 parts, charcoal not less than 10 parts, and purified paraffin (or Ozokerit) 1 part (*or* nitrate of potash 72 parts, and charcoal not less than 10 parts) by weight and sufficiently absorbent in quality when mixed in the above proportions to prevent exudation of nitro-glycerine.

Forcite, consisting of thoroughly purified nitro-glycerine, thickened by being combined with nitro-cellulose, carefully washed and purified, and mixed or incorporated with wood-meal and nitrate of potassium in such proportions that the whole shall be of such character and consistency as not to be liable to liquefaction or exudation.

Gelatine Dynamite No. 1, consisting of thoroughly purified nitro-glycerine, thickened by being combined with nitro-cotton, carefully washed and purified, and mixed or incorporated with one or more of the following non-explosive ingredients, viz., cotton, charcoal, or such other ingredients as may for the time being be sanctioned by a Secretary of State,† and in such proportions that the whole shall be of such character and consistency as not to be liable to liquefaction or exudation.

Gelatine Dynamite No. 2, consisting of gelatine dynamite No. 1 as above defined, mixed or incorporated with nitrate of potash or such other nitrate as may for the time being be sanctioned by a Secretary of State.

Lithofracteur, consisting of not more than 55 parts by weight of thoroughly purified nitro-glycerine, uniformly mixed with 45 parts by weight of a pulverized preparation, consisting of 1 part by weight of charcoal, bran, and sawdust (*or* of any one or more of the same), 3½ parts by weight of an infusorial earth known as Kieselguhr, 2½ parts by weight of nitrate of baryta and bicarbonate of soda (*or* of either of them), ½ part by weight of sulphur and manganese (*or* of either of them), and sufficiently absorbent in quality when mixed in the above proportions to prevent exudation of nitro-glycerine.

Matagnite Gelatine, consisting of thoroughly purified nitro-glycerine, and thoroughly purified nitro-benzol, or either of them, thickened by being combined with nitro-cellulose carefully washed and purified, and mixed or incorporated with wood-meal for the bleaching or purifying of which no chemical agents have been used, or if used have been absolutely removed, and nitrate of potassium or such other nitrate as may for the time being be sanctioned by a Secretary of State, in such proportions that the whole shall be of such character and consistency as not to be liable to liquefaction or exudation.

Oarite, consisting of not more than 2 parts by weight of thoroughly purified nitro-glycerine uniformly mixed with 8 parts by weight of the following preparation, viz.:—

Thoroughly purified nitro-cellulose 1 part, thoroughly purified di-nitro-benzol 1 part, nitrate of barium or nitrate of potassium or either of them, 6 parts.

Provided that the said preparation shall be sufficiently absorbent in quality when mixed in the above proportions to prevent exudation of nitro-glycerine.

Primers for Gelatines, consisting of not more than fifty (50) parts by weight of thoroughly purified nitro-glycerine uniformly mixed with fifty (50) parts by weight of thoroughly purified nitro-cotton, and with or without carbonate of calcium or carbonate of magnesium, the whole to be of such character as not to be liable to liquefaction or exudation of nitro-glycerine, even when entirely immersed in water and subjected to a constant pressure of not more than 2½ pounds on each primer.

Stonite, consisting of not more than 68 parts by weight of thoroughly purified nitro-glycerine, uniformly mixed with 32 parts by weight of a preparation consisting of nitrate of barium, nitrate of potassium (or either of them), kieselguhr (not less than 20 parts by weight), wood-meal (not less than 4 parts by weight), and carbonate of magnesia, with or without the addition of sulphuretted oil and soot (or either of them), such preparation to be sufficiently absorbent when mixed in the above proportions to prevent exudation of nitro-glycerine.

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* Up to the present time the following substances have been so sanctioned for addition to Dynamite, No. 1, viz.:—

Carbonate of Sodium
Sulphate of Barium
Mica
Talc
Ochre

} 8 parts (or less) by weight in substitution for an equal amount by weight of kieselguhr.

† Up to the present time the following substances have been so sanctioned for addition to Gelatine Dynamite, No. 1, viz.:—

Wood-meal for the bleaching or purifying of which no chemical agents have been used, or if used have been absolutely removed.
Carbonate of Lime.
Carbonate of Magnesia.

Division 2.

Amberite No. 2, consisting of thoroughly purified nitro-cellulose, whether or not mixed or impregnated with nitrate of potassium and nitrate of barium, or either of them, and with or without the addition of paraffin, vaseline, and graphite, or such other substance as may from time to time be approved by a Secretary of State.

Ammonite,* consisting of a mixture of nitrate of ammonium and thoroughly purified mono-nitro-naphthaline, or di-nitro-naphthaline, or a mixture of the two last-named ingredients made up into cartridges for blasting not containing their own means of ignition, contained or enclosed in a thoroughly waterproof case.

Blasting Amberite, consisting of Amberite No. 2, as above defined, mixed with or incorporated with wood-meal, for the bleaching or purifying of which no chemical agents have been used, or if used have been absolutely removed.

Bellite, consisting of a mixture of nitrate of ammonium and thoroughly purified meta-di-nitro-benzol.

B. N. Powder, consisting of thoroughly purified nitro-cellulose and tannin, partly gelatinized, incorporated with nitrate of barium and nitrate of potassium.

Cannonite No. 1, consisting of guncotton (consisting of thoroughly purified nitro-cellulose), mixed or impregnated with a nitrate or nitrates (other than nitrate of lead or nitrate of ammonium) and rosin, and with or without the addition of graphite.

Cannonite No. 2, consisting of guncotton (consisting of thoroughly purified nitro-cellulose) mixed or impregnated with rosin, and with or without the addition of graphite.

Chilworth Smokeless Sporting Powder, consisting of thoroughly purified nitro-cellulose gelatinized by a suitable process, and with or without the addition of nitrates (other than nitrate of ammonium).

Collodion Cotton, consisting of thoroughly purified nitro-cotton (*a*) of which not less than 15 per cent. is soluble in ether alcohol, and (*b*) which contains not more than 12·3 per cent. of nitrogen.

Cooppal's Powder, consisting of nitro-cellulose carefully purified with or without admixture of a nitrate or nitrates (other than nitrate of ammonium or nitrate of lead), hydro-carbons, resin, or such other substances as may from time to time be sanctioned by a Secretary of State.

C. L. Powder, consisting of nitro-cellulose thoroughly purified.

Di-flamyr, consisting of nitro-cellulose thoroughly purified, mixed or impregnated with a nitrate or nitrates other than nitrate of lead or nitrate of ammonium.

E.C. Sporting Powder, consisting of thoroughly purified nitro-cellulose mixed or impregnated with a nitrate or nitrates (other than nitrate of lead), with the addition of colouring matter consisting of auriue or ultramarine, both free from free mineral acid, and with or without the addition of any one or more of the following substances, viz., camphor, pure bees-wax, paraffin, shellac, gums, or resins (or such other substance as may from time to time be approved by a Secretary of State), dissolved in benzoline or other volatile solvent, such substances to be free from free mineral acid.

E.C. Powder Company's Rifle Powder, J. B. Patent, consisting of thoroughly purified nitro-cellulose mixed or impregnated with a nitrate or nitrates (other than nitrate of lead), with the addition of lampblack free from mineral acid or charcoal, and with or without the addition of camphor dissolved in benzoline or other volatile solvent.

Fortisine, consisting of a mixture of saltpetre, sulphur, and charcoal, with the addition of a di-nitro-benzol and resin or dextrine, provided 1st, that the amount of di-nitro-benzol shall not exceed 5 per cent. of the finished explosive; and 2nd, that all the ingredients shall be thoroughly purified.

Gathurst Powder, consisting of a mixture of (*a*) nitrate of potassium or nitrate of sodium with or without the admixture of neutral sulphate of ammonium, nitrate of ammonium, chloride of ammonium, sulphate of magnesium, and a colouring matter such as charcoal or lampblack (free from mineral acid), or all or any of them; and (*b*) thoroughly purified nitro and chloro-nitro compounds of benzine, toluene, and naphthaline with or without such other substances as may from time to time be approved by a Secretary of State. Provided that the finished explosive shall not contain more than two parts by weight of chlorine in every 100 parts of the finished explosive.

Guncotton, consisting of thoroughly purified† nitro-cotton (*a*), of which not more than 15 per cent. is soluble in ether alcohol, or (*b*) which contains more than 12·3 per cent. of nitrogen; and with or without carbonate of calcium.

Greener's Powder, consisting of a mixture of thoroughly purified nitro-cellulose with thoroughly purified nitro-benzol, or either of them, with the addition of colouring matter consisting of graphite, lampblack, or other suitable material, such colouring matter to be free from free mineral acid.

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* This explosive is authorized for manufacture and issue only in the form of cartridges for blasting not containing their own means of ignition, contained or enclosed in thoroughly waterproof cases.

† Some factories and magazines are still licensed for guncotton, defined as follows:—Guncotton, consisting of nitro-cellulose thoroughly purified, with or whithout the addition of carbonate of calcium. This also applies to some explosives in which guncotton enters as an ingredient.

Nitrated Guncotton, consisting of thoroughly purified guncotton mixed or impregnated with a nitrate or nitrates other than nitrate of lead.

Normal Smokeless Powder,* consisting of thoroughly purified nitro-cotton, with or without carbonate of calcium, and gelatinized by a suitable process.

Picric acid, consisting of tri-nitro-phenol containing not more than 0·5 per cent. of mineral matter or ash.

Potentite, consisting of guncotton thoroughly purified, mixed or impregnated with a nitrate or nitrates.

Rifleite, consisting of thoroughly purified nitro-lignin, dissolved in a safe and suitable solvent, with or without nitro-benzine and di-nitro-benzine, mixed or impregnated with a nitrate or nitrates (other than nitrate of lead and ammonium nitrate), or not so mixed or impregnated, and with or without the addition of graphite.

Rifle Guncotton, consisting of thoroughly purified guncotton, whether or not mixed with a nitrate or nitrates, other than nitrate of lead, mixed with any one or more of the following substances, viz., pure bees-wax, paraffin, shellac, gum, or resins dissolved in a solvent composed of ether, alcohol, and benzoline, and such substances to be free from free mineral acid.

Roburite No. 1, consisting of (*a*) nitrate of ammonium with or without an admixture of nitrate of sodium and neutral sulphate of ammonium, or either of them, provided that the amount of nitrate of sodium shall in no case exceed 50 per cent. of the total amount of nitrates present; and (*b*) thoroughly purified chlorinated di-nitro-benzol with or without the addition of thoroughly purified chloro-nitro-naphthaline and chloro-nitro-benzol; provided (1) that such chlorinated di-nitro-benzol shall not contain more than four (4) parts by weight of chlorine to every one hundred (100) parts by weight of chlorinated di-nitro-benzol; and (2) that the proportions of chloro-nitro-naphthaline and chloro-nitro-benzol shall not amount to more than 2 per cent. and 5 per cent. respectively of the finished explosive.

Roburite No. 2, consisting of Roburite No. 1, as above defined, with the addition of chloride of ammonium and sulphate of magnesium, or either of them.

Sawdust and Guncotton Powder, consisting of a mixture of two or more of the following explosives, viz., sawdust gunpowder,† guncotton, cotton gunpowder.‡

Schultze Gunpowder, consisting of nitro-lignin carefully purified and mixed or impregnated with a nitrate or nitrates, other than nitrate of lead, or nitrate of ammonium, and with or without starch or collodion (such collodion to consist of carefully purified nitro-lignin dissolved in a safe and suitable solvent), or pure solid paraffin, provided that such paraffin shall be free from mineral acid.

Schultze Blasting Powder, consisting of Schultze gunpowder as above defined mixed with charcoal or sugar.

Smokeless Powder, consisting of nitro-lignin carefully purified and mixed or impregnated with a nitrate or nitrates (other than nitrate of lead and ammonium nitrate), and with or without starch or collodion or turmeric or similar vegetable colouring matter, provided that such collodion shall consist of carefully purified nitro-lignin dissolved in a safe and suitable solvent, and with or without such other substance as may from time to time be approved by a Secretary of State§.

Smokeless Blasting Powder, consisting of smokeless powder as above defined, with the addition of any one or more of the following ingredients, viz., di-nitro-benzol, di-nitro-toluol, nitro-benzol, and nitro-naphthaline, provided that all such ingredients shall be thoroughly purified.

Tonite or Cotton Powder No. 1, consisting of guncotton thoroughly purified, mixed or impregnated with a nitrate or nitrates.

Tonite or Cotton Powder No. 2, consisting of guncotton thoroughly purified, mixed or impregnated with a nitrate or nitrates and charcoal.

Tonite or Cotton Powder No. 3, consisting of a mixture of thoroughly purified meta-di-nitro-benzol, and thoroughly purified guncotton, mixed or incorporated with one or more of the following ingredients, viz., nitrate of potassium, nitrate of sodium, nitrate of barium, and chalk.

Troisdorf Smokeless Powder, consisting of thoroughly purified nitro-cellulose, gelatinized by a suitable process, and with or without the addition of nitrates (other than nitrate of ammonium).

Von Forster's Smokeless Powder, consisting of thoroughly purified nitro-cellulose, gelatinized by a suitable process, and with or without the addition of carbonate of calcium or graphite, or such other substance as may from time to time be approved by a Secretary of State.

Walsrode Powder, consisting of thoroughly purified nitro-cellulose, mixed with carbonate of calcium, and gelatinized by a suitable process.

Class 4.—Chlorate Mixture.

Nil.

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* This explosive has become an authorised explosive whilst this Report has been in preparation, an Importation License having been taken out; it is therefore placed in the Authorized List.

† Sawdust gunpowder, defined as consisting of nitro-lignin thoroughly purified, mixed, or impregnated with a nitrate or nitrates.

‡ Cotton gunpowder is identical with Tonite or Cotton Powder No. 1 or Potentite.

§ In this case a substance has been sanctioned for addition by the Secretary of State, but at the request of the manufacturer, this addition is not to be made public.

Class 5.—Fulminate.

Fulminate of Mercury. *O. in C., No.* 1.

Cap Composition, consisting of chlorate of potash and sulphide of antimony or sulphur, with or without fulminate of mercury and ground glass.*

Class 6.—Ammunition.

Division 1.

Percussion Caps. *O. in C., No.* 1.

Railway Fog Signals, of such strength and construction, and containing an explosive in such quantity that the explosion of one such railway fog signal will not communicate the explosion to other like railway fog signals.

Safety Cartridges, consisting of cartridges for small arms, of which the case can be extracted from the small arm after firing, and which are so closed as to prevent any explosion in one cartridge being communicated to other cartridges. *Section* 108.

Safety Fuze, consisting of a fuze for blasting, which burns and does not explode, and which does not contain its own means of ignition, and which is of such strength and construction, and contains an explosive in such quantity that the burning of such fuze will not communicate laterally with other like fuzes. *O. in C., No.* 1.

Safety Firing Tubes, No. 1, consisting of a tube of metal or other suitable material, containing a percussion cap and suitable mechanical appliances for firing the same.

Tube Safety Fuze, consisting of a pipe or tube of pewter, coated externally with tarred yarns, tapes, or other suitable covering, and containing gunpowder in the proportion of not more than one and a half (1½) ounces to every twenty-four (24) feet of fuze.

Division 2.

(Not containing its own means of ignition.)

Cartridges for Small Arms (which are not Safety Cartridges). *O. in C., No.* 1.

Cartridges for Cannon, Shells, Mines, Blasting or other like purposes. *O. in C., No.* 1; also *Section* 44.

Abel's Electric Fuzes, consisting of a case of wood or other suitable material, containing two insulated wires, the terminals of which are (*a*) embedded in a charge, not exceeding two grains of the priming composition No. 1, herein-after specified, or (*b*) connected by a bridge of fine wire composed of a platinum alloy, steel, or other suitable material, the said bridge being embedded in a charge, not exceeding 10 grains of the priming material No. 2, herein-after specified; the case being either (*a*) filled with a charge not exceeding 20 grains of gunpowder and closed at the end, or (*b*) empty and open at the end, or (*c*) fitted with a small hollow cylinder of copper, sheet tin, or other material suitable for conversion into a detonator.

Priming composition, No. 1, consisting of sulphide of copper, phosphide of copper, and chlorate of potash, intimately mixed together.

Priming composition, No. 2, consisting of gunpowder and thoroughly purified guncotton.

Bickford's Patent Volley Firers, consisting of a small cylinder of tin-plate, zinc, wood, cardboard, or other suitable material, into one end of which is placed a socket or block of wood, or other suitable material, with a hole through the centre, and with a disc, wad, or cap made of, containing, or saturated with, a priming paste of mealed powder at the base of the same; the said cylinder and socket or block being fitted with safety fuze or instantaneous fuze or not so fitted.

Brain's Electric Fuzes, consisting of a case of wood or other suitable material, containing two insulated copper wires, the terminals of which are embedded in a priming composition consisting of an intimate mixture of chlorate of potash, native sulphide of antimony, and sub-phosphide of copper.

Electric Fuzes (Smith's Patent), consisting of a plug of sulphur containing two copper wires connected by a bridge of fine platinum or other suitable wire surrounded by a priming charge of fulminate of mercury not exceeding one-fifth of a grain in any one fuze.

Electric Fuzes, consisting of a case of metal, wood, paper, or other suitable material, containing two insulated wires connected by a fine wire of platinum or platinum alloy, and a charge of chlorate of potash and sulphide of antimony not exceeding in all five (5) grains, or in lieu, purified guncotton not exceeding 10 grains.

High Tension Electric Fuzes, consisting of a case of wood or other suitable material, containing two insulated wires, the terminals of which are embedded in a charge not exceeding two grains of a priming composition, consisting of sulphide of copper, phosphide of copper, and chlorate of potash intimately mixed together, the case being filled with a charge not exceeding 20 grains of gunpowder or carefully purified collodion cotton, and closed at the end. (No. 1 Definition.)

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* Licensed, under special restrictions, for one factory only (No. 12), and for the supply of neighbouring ammunition factories, not for general sale. Similar compositions are mixed at various ammunition factories, but forthwith placed into percussion caps, &c. on the premises. At the factory in question, fulminate of mercury and cap composition are the only manufactures carried on.

High Tension Electric Fuzes, consisting of a plug of wood or other suitable material containing two insulated copper wires, the terminals of which are embedded in a priming composition, consisting of an intimate mixture of chlorate of potassium, sulphide of antimony, silver precipitate, and plumbago. (No. 2 Definition.)

High Tension Electric Fuzes (Brain's Patent), consisting of a case of wood or other suitable material, containing two insulated copper wires, the terminals of which are embedded in a priming composition, consisting of an intimate mixture of chlorate of potash, native sulphide of antimony, platinum, and silver.

Low Tension Electric Fuzes, consisting of a case of glass or other suitable material, containing two insulated wires, the terminals of which are connected by a bridge of fine wire composed of a platinum alloy. (No. 1 Definition.)

Low Tension Electric Fuzes, consisting of a case of glass or other suitable material, containing two insulated wires, the terminals of which are connected by a bridge of fine wire composed of a platinum alloy, the case being filled with a charge not exceeding twenty (20) grains of (*a*) gunpowder, or (*b*) carefully purified collodion cotton, or (*c*) carefully purified guncotton. (No. 2 Definition.)

Low Tension Electric Fuzes, consisting of a case of glass or other suitable material, containing two insulated wires, the terminals of which are connected by a bridge of platinum wire, or other suitable material, embedded in a charge not exceeding 20 grains of (*a*) gunpowder, or (*b*) carefully purified collodion cotton, or (*c*) carefully purified guncotton, or (*d*) chlorate of potash and sulphide of antimony. (No. 3 Definition.)

Low Tension Electric Fuzes, consisting of a case of wood or other suitable material, containing two insulated wires, the terminals of which are connected by a bridge of fine wire, the said bridge being embedded in a charge not exceeding two grains of a priming composition, consisting of chlorate of potash, sulphide of antimony, and plumbago. (No. 4 Definition.)

Spon's Electric Fuzes, consisting of a case of metal, wood, paper, or other suitable material, containing two or more insulated wires, the terminals of which are (*a*) embedded in a charge not exceeding five grains of one or the other of the priming compositions (1), (2), (3), herein-after specified; or (*b*) connected by a bridge of fine wire composed of a platinum alloy, steel, or other suitable material, the said bridge being embedded in a charge not exceeding 10 grains of one or other of the priming compositions (4), (5), herein-after mentioned:—

Priming composition (1).—Chlorate of potash and sulphide of antimony, with or without powdered carbon.

Priming composition (2).—Chlorate of potash, sulphide of antimony, and phosphide of copper.

Priming composition (3).—Chlorate of potash, sulphide of copper, and phosphide of copper.

Priming composition (4).—Guncotton thoroughly purified.

Priming composition (5).—Guncotton thoroughly purified, chlorate of potash, and powdered galls.

Electric Primers, consisting of a case of metal or other suitable material containing two or more insulated wires the terminals of which are connected by a thin bridge of platinum wire, or other suitable material, embedded in a charge not exceeding 15 grains of a priming composition consisting of gunpowder and thoroughly purified guncotton.

Abel's Electric Tubes, consisting of a case of wood or other suitable material containing two insulated wires, the terminals of which are (*a*) embedded in a charge not exceeding two grains of the priming composition, No. 1, consisting of sulphide of copper, phosphide of copper, and chlorate of potash, intimately mixed together, or (*b*) connected by a bridge of fine wire composed of a platinum alloy, steel or other suitable material, the said bridge being embedded in a charge not exceeding ten grains of the priming composition, No. 2, viz., consisting of gunpowder and thoroughly purified guncotton, the case being fitted to a small cylindrical tube of quill, metal, or paper, or other suitable material, charged with gunpowder and having a hollow up the centre of the same.

Elswick Electric Tubes, consisting of a case of metal, wood, paper, or other suitable material containing (*a*) two or more insulated wires, the terminals of which are connected by a fine wire of platinum or other suitable material embedded in a charge not exceeding ten grains of guncotton thoroughly purified, and (*b*) a charge not exceeding one ounce of gunpowder; the said case being completely closed by means of a cork disc or other suitable material.

Fuzes for Shells, consisting of cases of wood, metal, or other suitable material, charged or primed with fuze or other suitable composition, and not containing their own means of ignition, and of such strength and construction that the explosion of one fuze will not produce an explosion en masse of other like fuzes.

Gunpowder Fuzes, consisting of cases of metal, wood, or other suitable material, containing a charge of gunpowder not exceeding two drams in each fuze.

Guncotton Fuzes, consisting of cases of metal, wood, or other suitable material, containing a charge of thoroughly purified guncotton, not exceeding two drams in each fuze.

Instantaneous Fuze, consisting of a preparation of gunpowder, yarn, and a protective coating, which is not a safety fuze, and does not contain its own means of ignition.

Pain's Instantaneous Pyrotechnic Fuzes, consisting of a closed case of paper, wood, or other suitable material, having affixed therein by means of a plug of sulphur two insulated copper wires the terminals of which are connected by a bridge of fine wire consisting of platinum, platinum alloy, steel, or other suitable material, such bridge being embedded in a charge of gunpowder not exceeding 20 grains.

German Spills, consisting of cylindrical cases of paper, containing a charge of gunpowder not exceeding one pound (1 lb.) per gross, and primed at one end with touch paper, and at the other with mealed gunpowder, or primed at both ends with mealed gunpowder.

Miners' Squibs, consisting of a tube of paper or other suitable material partly filled with gunpowder in the proportion of not more than one pound (1 lb.) of gunpowder to every 500 squibs and having one end closed with a plug of wax or other suitable material, and the other end closed by being twisted, and such twisted end being coated with sulphur, or not so coated.

Tubes for firing Explosives, consisting of cases of quill, metal, or paper, charged with mealed powder or other suitable explosive, and not containing their own means of ignition.

War Rockets, consisting of cases of iron or other suitable material, containing rocket composition consisting of an intimate mixture of saltpetre, sulphur, and charcoal, and not containing their own means of ignition.

Division 3.

(*Containing its own means of ignition.*)

Cartridges for Small Arms (which are not Safety Cartridges). *O. in C., No.* 1.

Electric Detonators, consisting of a detonator having two insulated wires connected by a fine platinum wire embedded in a priming composition consisting of chlorate of potash and sulphide of antimony, or purified guncotton, and so placed and secured that no part of the wires can come into contact with the fulminate in such detonator.

Abel's Electric Detonator Fuzes, consisting of a case of wood or other suitable material, containing two insulated wires, the terminals of which are (*a*) embedded in a charge not exceeding two grains of the priming composition No. 1, herein-after specified, or (*b*) connected by a bridge of fine wire composed of a platinum alloy, steel, or other suitable material, the said bridge being embedded in a charge not exceeding 10 grains of the priming material No. 2, herein-after specified, the case being fitted with a detonator :—

Priming composition No. 1, consisting of sulphide of copper, phosphide of copper, and chlorate of potash intimately mixed together.

Priming composition No. 2, consisting of gunpowder and thoroughly purified guncotton.

Bornhardt's Electric Detonator Fuzes, consisting of a detonator as defined by Order in Council made under 106th section of the Act, such detonator having inserted therein two insulated wires, the terminals of which are embedded in a priming composition composed of chlorate of potash and native sulphide of antimony, and the detonator being so constructed, and the wires so adjusted and secured that the terminals of the said wires cannot come into contact with the fulminate in the said detonators.

Brain's Electric Detonator Fuzes, consisting of Brain's Electric Fuzes as above described (*see* definition in Division 2), and having attached thereto a detonator as defined by Order in Council made under the 106th section of the Explosives Act, 1875.

Electric Detonator Fuzes (Smith's Patent), consisting of electric fuzes as above described (*see* definition in Division 2), and having attached thereto a detonator as defined by an Order in Council made under the 106th section of the said Act. Provided that no one such electric detonator fuze shall contain more than thirty (30) grains of explosive of the 5th (Fulminate) Class, as defined in the said Order.

Electric Detonator Fuzes, consisting of electric fuzes as above described (*see* definition in Division 2) inserted into a detonator, and so secured that the electric fuze cannot come into contact with the fulminate in such detonator.

High Tension Electric Detonator Fuzes, consisting of high tension electric fuzes as above described (*see* definitions, Nos. 1 and 2, in Division 2), and having attached thereto a detonator as defined by an Order in Council, made under the 106th section of the Explosives Act, 1875.

Low Tension Electric Detonator Fuzes, consisting of low tension electric fuzes as above described (*see* definition No. 1 in Division 2), and having the platinum wire embedded in a charge not exceeding two (2) grains of a priming composition consisting of (*a*) carefully purified guncotton or (*b*) carefully purified collodion cotton and the case being fitted with a detonator.

Low Tension Electric Detonator Fuzes, consisting of low tension electric fuzes, as above described (*see* definitions Nos. 2, 3, and 4, in Division 2), and having attached thereto a detonator as defined by an Order in Council, made under the 106th section of the Explosives Act, 1875.

Spon's Electric Detonator Fuzes, consisting of Spon's Electric Fuzes as above described (*see* definition in Division 2), and having attached thereto a detonator as defined by an Order in Council made under the 106th section of the Act.

Fuzes for Shell, consisting of cases of wood or metal, or other suitable material, charged or primed with fuze or other suitable composition, containing their own means of ignition, and of such strength and construction that the explosion of one fuze will not produce an explosion en masse of other like fuzes.

Colliery Safety Lighters, consisting of a tube of metal, millboard, or other suitable material, closed at one end, and containing sulphuric acid enclosed in a glass globule or tube embedded in or contiguous to a mixture of chlorate of potassium and sugar (whether or not contained in an inner metallic tube, containing or not containing gunpowder), and with or without the addition of a piece of safety-fuze. Provided that the amount of the mixture aforesaid contained in any one of the said colliery safety lighters shall not exceed five (5) grains. Provided also that the said colliery safety lighters shall be of such strength and construction that the ignition of one such colliery safety lighter will not communicate laterally with others.

Detonators, consisting of a capsule or case of such strength and construction, and containing an explosive of the fulminate class in such quantity that the explosion of one capsule or case will communicate the explosion to other like capsules or cases. *O. in C., No.* 1.

Tubes for Firing Explosives (other than Detonators), consisting of cases of quill, metal, or paper, charged with mealed powder or other suitable explosive, and containing their own means of ignition.

Elswick Mechanical Tubes, consisting of a case of metal, wood, paper, or other suitable material, containing its own means of ignition and a charge not exceeding one ounce of gunpowder.

Safety Firing Tubes, No. 2, consisting of Safety Firing Tubes, No. 1 (*see* above in Division 1), with the addition of a priming charge of meal powder not exceeding 40 grains. The whole to be of such construction that the explosion of one will not communicate to others in close contact.

Class 7.—Fireworks.

Division 1.

Firework Composition, consisting of any chemical compound or mechanically mixed preparation of an explosive or inflammable nature which is used for the purpose of making manufactured fireworks, and is not included in the former classes of explosives, and also any coloured fire composition. *O. in C., No.* 1.

Division 2.

Amorces (whether in the form of toy caps or igniting tapes), consisting of dots of one or other of the under-mentioned compositions enclosed between two pieces of paper, or separated by a sheet of paper or cardboard, in a proportion not exceeding seventy (70) grains of such composition to every one thousand (1,000) dots.

Composition (*a*): A mixture of chlorate of potassium and amorphous phosphorous, with or without the addition of (1) nitrate of potassium, sulphide of antimony and powdered sulphur (free from acid), or (2) chalk, rye, flour, and resin (sandarak), or (3) manganese and glue; or (4) such other substance as may from time to time be approved by the Secretary of State; provided that the amount of amorphous phosphorous present in the mixture shall in no case exceed the proportion of ten (10) grains in one thousand (1,000) dots.

Composition (*b*): A mixture of chlorate of potassium and ferrocyanide of lead.

Crack Shots, consisting of an amorce composed of a patch of thoroughly purified fulminate of silver enclosed between two pieces of paper in a proportion not exceeding fifteen (15) grains of such fulminate of silver to every one thousand (1,000) amorces, such amorce to be gummed to or form part of a sheet of paper not less than four (4) inches square, and having a strip impregnated with nitre.

Manufactured Fireworks, consisting of any explosive of the foregoing classes, and any firework composition, when such explosive or composition is enclosed in any case or contrivance, or is otherwise manufactured so as to form a squib, cracker, serpent, rocket (other than a war rocket), maroon, lance, wheel, Chinese fire, Roman candle, or other article specially adapted for the production of pyrotechnic effects or pyrotechnic signals, or sound signals. Provided that a substantially constructed and hermetically closed metal case containing not more than 1 lb. of coloured fire composition of such a nature as not to be liable to spontaneous ignition shall be deemed to be a manufactured firework. *O. in C., No.* 1 (*a*).

Socket Sound Signals, consisting of a case of tinned iron, containing one or more charges of tonite or cotton powder as herein-after described, such charges not exceeding together eight (8) ounces, and having inside the base of the said case, or attached to the exterior thereof in a case or bag of india-rubber, canvas, or other suitable material, a charge of gunpowder not exceeding two and a half (2½) ounces; the charges of tonite and gunpowder being connected by means of a suitable time fuze of wood, copper, or tinned iron, in communication or connexion with a detonator as defined by an Order in Council made under the 106th section of the said Act, such detonator to contain above the fulminate a substantial layer of strongly compressed mealed gunpowder, and being itself embedded in tonite, the said tonite to consist of guncotton thoroughly purified, mixed or impregnated with a nitrate or nitrates.

Socket Distress Signals, consisting of a socket sound signal as above described, in the upper part thereof a star or stars composed of two or more of the following ingredients, viz., saltpetre, sulphur (carefully washed), realgar, antimony, gunpowder; or one or more stars of the following composition, viz., *Red Stars*, consisting of nitrate of strontia, chlorate of potash, charcoal, and shellac incorporated with shellac solution, and with or without the addition of guncotton thoroughly purified, not exceeding 10 per cent. by weight of the finished stars. *Green Stars*, consisting of nitrate of baryta, chlorate of potash, charcoal, and shellac incorporated with shellac solution, and with or without the addition of guncotton thoroughly purified, not exceeding 10 per cent. by weight of the finished stars. *White Stars*, consisting of nitrate of potash, sulphur (carefully washed), sulphide of antimony, realgar, gunpowder, and magnesium, incorporated with shellac solution, and with or without the addition of guncotton, thoroughly purified, not exceeding 10 per cent. by weight of the finished stars Provided that each star may have a strand not exceeding five (5) grains in weight of thoroughly purified nitro-cellulose attached to and passing through it.

Sound Signal Rockets, consisting of a signal rocket, having fitted in the head thereof one or more charges of tonite or cotton powder as herein-after described, and with or without a layer of compressed gunpowder made of sulphur free from acid, saltpetre, and charcoal between the said charges, and having embedded in the said charges one or more detonators as defined by an Order in Council made under the 106th section of the said Act, such detonators to contain above the fulminate a substantial layer either of strongly compressed mealed gunpowder, or of a composition made of two or more of the following ingredients, viz., saltpetre, sulphur (carefully washed), realgar, antimony, gunpowder; the said tonite to consist of guncotton thoroughly purified, mixed or impregnated with a nitrate or nitrates.

Socket Light Signals, consisting of a case of tin or other suitable material, containing one or more white or coloured stars of the compositions herein-after specified, and having attached to the base of the said case in a case or bag of india-rubber, canvas, or other suitable material, a charge of gunpowder not exceeding 2½ ozs., the said stars and gunpowder being connected by means of a suitable time fuze of wood, copper, tinned iron, or other suitable material. Provided that the total weight of the star or stars contained in any one signal shall not exceed 8 ozs. *Red Stars*, consisting of nitrate of strontia, chlorate of potash, charcoal, and shellac, incorporated with shellac solution, with or without the addition of guncotton thoroughly purified, not exceeding 10 per cent. by weight of the finished stars. *Green Stars*, consisting of nitrate of baryta, chlorate of potash, charcoal, and shellac incorporated with shellac solution, with or without the addition of guncotton thoroughly purified, not exceeding 10 per cent. by weight of the finished stars. *White Stars*, consisting of nitrate of potash, sulphur (carefully washed), sulphide of antimony, realgar, gunpowder, and magnesium incorporated with shellac solution, with or without the addition of guncotton thoroughly purified, not exceeding 10 per cent. by weight of the finished stars. Provided that each star may have a strand not exceeding five (5) grains in weight of thoroughly purified nitro-cellulose attached to or passing through it.

Distress Signal Rockets, consisting of sound signal rockets as above described, with the addition in the head of the rocket of one or more stars composed of two or more of the following ingredients, viz., saltpetre, sulphur (carefully washed), realgar, antimony, gunpowder.

Throwdowns.
Snaps for Bonbon Crackers. } Licensed as "Toy Fireworks."

Magic Candle Pin Crackers, consisting of thoroughly purified fulminate of silver, gummed, or otherwise attached to a pin, and protected by a coating of paper, in a proportion not exceeding fifteen (15) grains of such fulminate of silver to every one thousand (1,000) magic candle pin crackers.*

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* It is a condition of the license that these crackers shall be packed in numbers not exceeding twelve, in stout paper, and each such package placed singly in a box of wood or cardboard, properly secured against escape of explosive; such boxes to be further packed as required for fireworks.

APPENDIX D(2).

List of Explosives which have passed the tests and therefore become licensable, but for which no licenses have yet been taken out.

Class 2.—Nitrate Mixture.

Lithotrite, consisting of a mechanical mixture of nitrate of potassium, sawdust, charcoal, and sulphur, with or without the addition of nitrate of sodium. (Annual Report for 1888, p. 24; $\frac{X1293}{1—4}$).

Class 3.—Nitro-Compound.

Division 1.

Dynamite, No. 0, consisting of not more than 75 parts by weight of thoroughly purified nitro-glycerine uniformly mixed with 25 per cent. of thoroughly purified wood pulp sufficiently absorbent in quality, when mixed in the above proportions, to prevent exudation of nitro-glycerine.

Provided that there may be added to the wood pulp an amount of carbonate of lime, or carbonate of magnesium, not exceeding 1½ parts by weight in every 100 parts by weight of the finished explosive. (Annual Report for 1892, p. 18; X2286A.)

Nitro-magnite,* consisting of not more than 75 parts by weight of thoroughly purified nitro-glycerine, uniformly mixed or absorbed by 25 parts by weight of well washed magnesia alba (prepared hydro-carbonate of magnesia) and sufficiently absorbent in quality, when mixed in the above proportions, to prevent exudation of nitro-glycerine. (Annual Report for 1879, p. 6; 79,052.)

Safety Dynamite,† consisting of not more than 75 parts by weight of a thoroughly purified mixture of nitro-glycerine and nitro-benzol, or di-nitro-benzol, or both, uniformly mixed with 25 parts by weight of—

(*a*) An infusorial earth, known as "kieselguhr," or

(*b*) A non-explosive mixture of kieselguhr with such other ingredients, and in such proportions, as may for the time being be sanctioned by the Secretary of State;

Provided—

(1.) That the said (*a*) kieselguhr, or (*b*) non-explosive mixture, shall be sufficiently absorbent in quality when mixed in the above proportions to prevent exudation of nitro-glycerine; and

(2.) That there may be added to the kieselguhr or non-explosive mixture an amount of carbonate of ammonium not exceeding 1½ parts by weight in every 100 parts by weight of the finished dynamite. (Annual Report for 1889, p. 20; $\frac{X22,374}{2}$).

Standard Dynamite, No. 1,‡ consisting of not more than 60 parts by weight of thoroughly purified nitro-glycerine, mixed or combined with 40 parts by weight of nitro-cotton, as hereinafter defined; the whole to be of such character and consistency when mixed or combined in the above proportions as not to be liable to liquefaction or exudation.

Nitro-cotton, consisting of nitro-cellulose carefully washed and purified. (Annual Report for 1885, p. 31; $\frac{A22,116A}{22}$).

Standard Dynamite, No. 2, consisting of not more than 60 parts by weight of thoroughly purified nitro-glycerine, uniformly mixed or combined with 40 parts by weight of a preparation composed of nitro-cotton, as herein-after defined, and nitrate of potassium or nitrate of barium, and the whole to be of such character and consistency when mixed or combined in the above proportions as not to be liable to liquefaction or exudation.

Nitro-cotton, consisting of nitro-cellulose carefully washed and purified. (*Ibid*).

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* It was at first proposed to give this explosive the name of "Dynamagnite."

† Herr Von Dahmen (the inventor of this explosive) was informed that the Secretary of State was not prepared to assent to the use of the name "Safety Dynamite."

‡ The applicant was informed that there were objections to the use of the name "Standard Dynamite," and accordingly before the explosive is actually licensed some other name will have to be adopted for it.

Virite, No. 1, consisting of not more than 5 parts by weight of thoroughly purified nitro-glycerine, absorbed in not less than 9½ parts by weight of pulverized charcoal of such character as to retain the whole of the nitro-glycerine when immersed in water at ordinary temperatures. Such nitro-glycerine and charcoal being further mixed with not less than 33½ parts by weight of pulverised nitrate of potassium, the whole to be of such character as not to be liable to exudation of nitro-glycerine. (Annual Report for 1882, pp. 5 and 24; $\frac{52,819G}{1—7.}$).

Division 2.

Bronolithe, No. 1, consisting of a mixture of saltpetre, dextrine, sugar, and charcoal, with or without the addition of picrates of barium, sodium, and potassium, or any of them, and with or without the addition of nitro-naphthaline. Provided that the finished explosive shall not contain more than five per cent. by weight of picrates, or more than 8 per cent. by weight of nitro-naphthaline. Provided also that all the ingredients shall be thoroughly purified. (Annual Report for 1889, p. 20; X7428.)

Bronolithe, No. 2, consisting of a mixture of the picrates of barium, sodium, and potassium, with saltpetre, nitro-naphthaline, sugar, dextrine, and lampblack (or charcoal). Provided that the total amount of saltpetre and nitro-naphthaline present in the finished explosive shall not be less than 10 per cent. by weight.

Provided also that the ingredients shall be thoroughly purified. (Annual Report for 1889, p. 20; X7428.)

Electronite, consisting of blasting amberite as above defined, mixed or impregnated with carbonate of calcium. (*See* p. 21; $\frac{51059\ H}{61.}$).

Emerald Powder, consisting of Cooppal's Powder, as above defined (Class 3, Division 2), coloured with the oxalate variety of malachite green. (*See* p. 22, X2286A.)

Granulite, consisting of nitro-cotton, thoroughly purified, mixed, or impregnated with, a nitrate or nitrates (other than nitrate of ammonium or nitrate of lead, and with or without charcoal and paraffin. (*See* p. 21, X30,960.)

Kolf's Powder, consisting of nitro-cotton 1 part, nitro-lignin and nitro-starch together 1 part all thoroughly purified and gelatinized by means of a suitable solvent, the finished product not to contain more than 2 per cent. of nitrate of potassium and not more than 0·5 per cent. of sulphur, Annual Report for 1892, p. 18 $\frac{X37559}{5}$).

Plastomenite, consisting of thoroughly purified nitro-cotton mixed or incorporated with thoroughly purified di-nitro-toluol and nitrate of barium. (*See* p. 21, X45,077.)

Rosslyn Smokeless Powder, No. 1, consisting of nitro-cotton, thoroughly purified, mixed or impregnated with nitrate of barium and nitrate of potassium, or either of them, and paraffin or vaseline, such paraffin or vaseline to be free from mineral acid, and starch. (*See* p. 21, 50,681.)

Class 4.—Chlorate Mixture.

Cycene, consisting of not more than 3 parts by weight of chlorate of potassium mixed with 15 parts by weight of a preparation consisting of nitrate of potassium 7 parts, cane sugar 7 parts, and paraffin oil (or coal dust) 1 part; provided that the paraffin oil shall be free from free mineral acid, and that the coal dust (if any) shall be free from iron pyrites. (Annual Report for 1890, p. 19; $\frac{X25,768}{10}$).

Class 5.—Fulminate.

Nil.

Class 6.—Ammunition.

Division 3

Explosive Trap Shells, consisting of hemispherical shells made of two or more layers of stout paper, cardboard, or papier maché, firmly held together, and having between the layers a mixture of the following composition, viz., chlorate of potassium, sulphide of antimony, amorphous

phosphorus and fine sand (or powdered glass or other similar material), such mixture not to exceed 25 grains for each hemisphere, and the whole to be of such character and construction that (*a*) no escape of any portion of the composition from the shell can take place, and (*b*) the explosion by percussion of one hemisphere will not communicate to another like hemisphere placed inside and in close contact with the hemisphere in which the explosion occurred. (Annual Report, 1880, p. 6.—89,800.)

APPENDIX D (3).

List of Explosives* which were at one time licensed for manufacture or importation but for which no licenses are at present in force.

Class 2.—Nitrate Mixture.

Espir's Explosive Powder, consisting of a mechanical mixture of nitrate of sodium, sulphur, and sawdust.

(Licensed for manufacture from 1878 to 1885.)

Pudrolithe, consisting of a mixture of any two or more of the following ingredients, viz., tan, sawdust, nitrate of soda, nitrate of baryta, charcoal, sulphur, and saltpetre.

(Licensed for manufacture from 1876 to 1881.)

Class 3.—Nitro-Compound.

Division 2.

Compressed Securite, consisting of a mixture of nitrate of potassium and nitrate of barium (or either of them) with thoroughly purified nitro-cellulose and one or more of the following substances :—

Thoroughly purified meta-di-nitro-benzol.
Thoroughly purified di-nitro-toluol.
Thoroughly purified nitro-naphthaline.
Thoroughly purified di-nitro-naphthaline.

(Licensed for manufacture from 1891 to 1893.)

Denaby Powder, consisting of compressed securite, as above defined, with the addition of charcoal.

(Licensed for manufacture from 1891 to 1893.)

E. C. Sporting Powder, J. B. Patent, consisting of thoroughly purified nitro-cellulose mixed or impregnated with a nitrate or nitrates (other than nitrate of lead) with the addition of colouring matter, consisting of ultramarine free from mineral acid, and with or without the addition of camphor dissolved in benzoline or other volatile solvent.

(Licensed for manufacture during 1888 and 1889.)

E. C. Powder Company's Rifle Powder, consisting of rifle guncotton as above defined (*see* page 89), with the addition of colouring matter consisting of picric acid (free from mineral acid) dissolved in a solvent composed of ether, alcohol, and benzoline.

(Licensed for manufacture from 1882 to 1889.)

Flameless Securite, consisting of securite as herein defined, with the addition of oxalate of ammonium.

(Licensed for manufacture, 1889.)

Securite, consisting of a mixture of nitrate of potassium or nitrate of ammonium with thoroughly purified meta-di-nitro-benzol, with or without the addition of oxalate of ammonium.

(Licensed for manufacture from 1889 to 1894.)

Wood Gunpowder, consisting of nitro lignin carefully purified and mixed or impregnated with a nitrate or nitrates.

(Licensed for manufacture from 1877 to 1880.)

Xylobrome, consisting of nitro-lignin, carefully purified and mixed or impregnated with a nitrate or nitrates.

(Licensed for manufacture from 1877 to 1879.)

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* In cases where the definition has been altered, only the latest definition is given.

Class 4.—Chlorate Mixture.*

Asphaline, No. 1, consisting of a mixture of chlorate of potassium and bran, as herein-after defined, and with or without an admixture of one or more of the following ingredients, viz., nitrate of potassium, sulphate of potassium, paraffin oil, paraffin, ozokerit (such paraffin oil, paraffin, and ozokerit to be free from mineral acid), soap and fuchsine, such mixture to contain not more than 54 parts by weight of chlorate of potassium and four parts by weight of nitrate of potassium and sulphate of potassium to every 42 parts by weight of bran. Bran, consisting of wheat bran or barley bran, thoroughly cleansed and reasonably free from flour.

(Licensed for manufacture from 1882 to 1886.)

Asphaline No. 2, consisting of Asphaline No. 1 as above defined, with the addition of nitrate of potassium in such proportion that the total amount of nitrate of potassium present shall not exceed 25 parts by weight in 100 parts by weight of the finished explosive.

(Licensed for manufacture from 1882 to 1886.)

Class 6.—Ammunition.

Division 2.

Bornhardt's Electric Fuzes, consisting of a case of wood or other suitable material containing two insulated wires, the terminals of which are embedded in a priming composition composed of chlorate of potash and sulphide of antimony, and containing a charge of gunpowder not exceeding 30 grains in any one such fuze.

(Licensed for Importation in 1889.)

Hunters' Patent Miner's Fuzes, consisting of a cylindrical tube of paper varnished or coated with a suitable waterproof solution and filled with gunpowder, in the proportion of not more than one pound of gunpowder to every 500 fuzes, the paper tube being closed at both ends, and having one end primed with a solution of nitrate of potassium or nitrate of sodium, or with melted sulphur (with or without nitrate of potassium).

(Licensed for manufacture from 1882 to 1885.)

APPENDIX E (1).

Distribution in Counties of Factories, Magazines, and Toy Firework Factories.

Counties.	Factories.			Magazines.			Toy Firework Factories.
	Under Continuing Certificate.	Under License.	Total.	Under Continuing Certificate.	Under License.	Total.	
ENGLAND AND WALES.							
Anglesey	—	—	—	1	1	2	—
Bedford	—	—	—	—	—	—	—
Berks	—	—	—	—	—	—	—
Brecon	—	—	—	—	—	—	—
Buckingham	—	—	—	—	—	—	—
Cambridge	—	—	—	—	—	—	—
Cardigan	—	—	—	3	1	4	—
Carmarthen	—	1	1	1	2	3	—
Carnarvon	—	—	—	3	11	14	—
Chester	—	—	—	3	6†	9	—
Cornwall	4	9	13	6	17	23	—
Cumberland	—	2	2	2	18	20	—
Denbigh	—	1	1	1	5	6	—
Derby	1	2	3	5	2	7	—
Devon	1	—	1	5	3	8	—
Dorset	—	—	—	—	—	—	—
Durham	—	3	3	10	8	18	—
Carried forward	6	18	24	40	74	114	—

* Previous to the coming into operation of the Explosives Act, 1875, certain other nitro-glycerine preparations, *e.g.*, Horsley's Blasting Powders A. and B., and Brain's Blasting Powder were licensed under the Nitro-Glycerine Act of 1869 (*see* Annual Report for 1875); but no licenses for these were taken out under the Explosives Act, 1875.

† Including the three floating magazines in the River Mersey, which are under special legislation.

Counties.	Factories.			Magazines.			Toy Firework Factories.
	Under Continuing Certificate.	Under License.	Total.	Under Continuing Certificate.	Under License.	Total.	
ENGLAND AND WALES—*cont.*							
Brought forward	6	18	24	40	74	114	—
Essex	—	5	5	7	11	18	—
Flint	—	—	—	2	1	3	—
Glamorgan	1	1	2	4	11	15	—
Gloucester	—	3	3	4	3	7	—
Hants	1	—	1	—	—	—	—
Hereford	—	—	—	—	—	—	—
Hertford	—	1	1	—	—	—	—
Huntingdon	—	—	—	—	—	—	—
Kent	7	10	17	2	12	14	—
Lancaster	4	6	10	9	12	21	1
Leicester	—	1	1	1	2	3	—
Lincoln	—	—	—	—	—	—	—
Merioneth	1	1	2	6	10	16	—
Middlesex	2	5	7	1	—	1	9
Monmouth	—	1	1	7	1	8	—
Montgomery	—	—	—	2	1	3	—
Norfolk	—	—	—	—	—	—	—
Northampton	—	—	—	—	—	—	—
Northumberland	—	5	5	8	7	15	—
Nottingham	—	2	2	1	6	7	—
Oxford	—	—	—	—	—	—	—
Pembroke	—	—	—	2	2	4	—
Radnor	—	—	—	—	1	1	—
Rutland	—	—	—	—	—	—	—
Salop	—	—	—	1	4	5	—
Somerset	—	—	—	1	3	4	—
Stafford	2	2	4	15	7	22	—
Suffolk	1	1	2	—	—	—	—
Surrey	1	5	6	—	—	—	1
Sussex	—	—	—	—	—	—	—
Warwick	1	4	5	1	1	2	—
Westmoreland	4	—	4	—	—	—	—
Wilts	—	—	—	—	—	—	—
Worcester	1	4	5	1	—	1	—
York	4	2	6	11	25	36	—
Totals	36	77	113	126	194	320	11
SCOTLAND.							
Aberdeen	—	—	—	—	4	4	—
Argyll	1	1	2	—	4	4	—
Ayr	1	3	4	1	2	3	—
Banff	—	—	—	1	1	2	—
Berwick	—	—	—	—	—	—	—
Bute	—	—	—	—	—	—	—
Caithness	—	—	—	—	—	—	—
Clackmannan	—	—	—	—	1	1	—
Cromarty	—	—	—	—	—	—	—
Carried forward	2	4	6	2	12	14	—

Counties.	Factories.			Magazines.			Toy Firework Factories.
	Under Continuing Certificate.	Under License.	Total.	Under Continuing Certificate.	Under License.	Total.	
SCOTLAND—*cont.*							
Brought forward	2	4	6	2	12	14	—
Dumbarton	—	—	—	—	—	—	—
Dumfries	—	—	—	—	—	—	—
Edinburgh	1	4	5	3	1	4	—
Elgin	—	—	—	—	—	—	—
Fife	—	—	—	2	4	6	—
Forfar	—	—	—	—	3	3	—
Haddington	—	—	—	—	—	—	—
Inverness	—	—	—	—	1	1	—
Kincardine	—	—	—	—	—	—	—
Kinross	—	—	—	—	—	—	—
Kirkcudbright	—	—	—	—	—	—	—
Lanark	—	1	1	2	4	6	—
Linlithgow	—	—	—	—	3	3	—
Nairn	—	—	—	—	—	—	—
Orkney and Shetland	—	—	—	—	—	—	—
Peebles	—	—	—	—	—	—	—
Perth	—	—	—	—	1	1	—
Renfrew	—	—	—	1	1	2	—
Ross	—	—	—	—	—	—	—
Roxburgh	—	—	—	—	—	—	—
Selkirk	—	—	—	—	—	—	—
Stirling	1	1	2	1	4	5	—
Sutherland	—	—	—	—	—	—	—
Wigton	—	—	—	—	—	—	—
Totals	4	10	14	11	34	45	—
IRELAND.							
Antrim	—	—	—	—	3	3	—
Armagh	—	—	—	—	—	—	—
Carlow	—	—	—	—	—	—	—
Cavan	—	—	—	—	—	—	—
Clare	—	—	—	—	—	—	—
Cork	1	—	1	—	1	1	—
Donegal	—	—	—	—	—	—	—
Down	—	1	1	1	—	1	—
Dublin	—	1	1	—	7	7	—
Fermanagh	—	—	—	—	—	—	—
Galway	—	—	—	1	—	1	—
Kerry	—	—	—	—	—	—	—
Kildare	—	—	—	—	—	—	—
Kilkenny	—	—	—	—	—	—	—
King's County	—	—	—	—	—	—	—
Leitrim	—	—	—	—	—	—	—
Limerick	—	—	—	—	1	1	—
Londonderry	—	—	—	—	1	1	—
Longford	—	—	—	—	—	—	—
Louth	—	—	—	—	—	—	—
Totals	1	2	3	2	13	15	—

Counties.	Factories.			Magazines.			Toy Firework Factories.
	Under Continuing Certificate.	Under License.	Total.	Under Continuing Certificate.	Under License.	Total.	
IRELAND—*cont.*							
Brought forward -	1	2	3	2	13	15	—
Mayo - - - -	—	—	—	—	—	—	—
Meath - - - -	—	—	—	—	—	—	—
Monaghan - - -	—	—	—	—	—	—	—
Queen's County - - -	—	—	—	—	—	—	—
Roscommon - - -	—	—	—	—	—	—	—
Sligo - - - -	—	—	—	—	—	—	—
Tipperary - - - -	—	—	—	—	—	—	—
Tyrone - - - -	—	—	—	—	—	—	—
Waterford - - - -	—	—	—	—	—	—	—
Westmeath - - -	—	—	—	—	—	—	—
Wexford - - - -	—	—	—	—	—	—	—
Wicklow - - -	—	—	—	—	—	—	—
Totals - - -	1	2	3	2	13	15	—
SUMMARY.							
ENGLAND AND WALES - - -	36	77	113	126	194	320	11
SCOTLAND - - - -	4	10	14	11	34	45	—
IRELAND - - - -	1	2	3	2	13	15	—
Grand Totals - -	41	89	130	139	241	380	11

APPENDIX E (2).

DISTRIBUTION in COUNTIES of STORES, SMALL FIREWORK FACTORIES, and REGISTERED PREMISES.

Counties.	Stores.			Small Firework Factories.	Registered Premises.	Remarks.
	Under Continuing Certificate.	Under License.	Total.			
ENGLAND AND WALES.						
Anglesey - - -	—	2	2	—	17	
Bedford - - -	—	2	2	—	65	
Berks - - -	—	—	—	—	112	
Brecon - - -	—	11	11	—	37	
Buckingham - - -	—	—	—	—	88	
Cambridge - - -	—	—	—	1	38	
Cardigan - - -	—	21	21	—	20	
Carmarthen - -	—	13	13	—	125	
Carried forward -	—	49	49	1	502	

Counties.	Stores.			Small Firework Factories.	Registered Premises.	Remarks.
	Under Continuing Certificate.	Under License.	Total.			
ENGLAND AND WALES—*cont.*						
Brought forward -	—	49	49	1	502	
Carnarvon - - -	6	46	52	—	53	
Chester - - -	—	29	29	—	492	
Cornwall - - -	25	91	116	—	191	
Cumberland - - -	8	95	103	—	131	
Denbigh - - -	1	28	29	—	56	
Derby - - -	2	94	96	—	576	
Devon - - -	—	46	46	2	445	
Dorset - - -	—	2	2	—	34	
Durham - - -	8	114	122	—	1,017	
Essex - - -	—	1	1	2	590	
Flint - - -	2	38	40	—	42	
Glamorgan - - -	—	85	85	—	425	
Gloucester - - -	—	21	21	3	514	
Hants - - -	—	5	5	—	294	
Hereford - - -	—	2	2	—	65	
Hertford - - -	1	—	1	—	94	
Huntingdon - - -	1	—	1	—	37	
Isle of Wight - - -	—	—	—	—	40	
Kent - - - -	—	3	3	—	446	
Lancaster - - -	43	149	192	1	4,507	
Leicester - - -	11	19	30	—	210	
Lincoln - - -	—	10	10	1	365	
London - - -	—	1	1	3	3,420	
Merioneth - - -	—	31	31	—	24	
Middlesex - - -	—	—	—	—	344	
Monmouth - - -	—	22	22	—	329	
Montgomery - -	—	9	9	—	82	
Norfolk - - -	—	6	6	—	344	
Northampton - -	—	3	3	—	136	
Northumberland - -	19	79	98	—	342	
Nottingham - - -	—	25	25	—	366	
Oxford - - - -	—	3	3	—	90	
Pembroke - - -	—	5	5	—	42	
Radnor - - -	—	1	1	—	—	
Rutland - - -	—	—	—	—	11	
Salop - - -	9	25	34	—	142	
Somerset - - -	—	19	19	—	273	
Stafford - - -	24	120	144	1	706	
Suffolk - - -	—	2	2	—	258	
Surrey - - -	—	3	3	—	366	
Sussex - - -	—	2	2	1	539	
Warwick - - -	4	23	27	2	1,092	
Westmoreland - - -	—	18	18	—	61	
Wilts - - -	—	—	—	—	54	
Worcester - - -	—	10	10	—	230	
York - N.R. - -	14	19	33	—	362	
York - E.R. - -	—	—	—	—	261	
York - W.R. - -	6	161	167	2	3,846	
Totals - -	184	1,514	1,698	19	24,846	

Counties.	Stores.			Small Firework Factories.	Registered Premises.	Remarks.
	Under Continuing Certificate.	Under License.	Total.			
SCOTLAND.						
Aberdeen	—	32	32	—	162	
Argyll	4	17	21	—	16	
Ayr	4	49	53	—	253	
Banff	—	7	7	—	32	
Berwick	—	3	3	—	23	
Bute	—	—	—	—	5	
Caithness	—	—	—	—	18	
Clackmannan	—	4	4	—	22	
Cromarty	—	—	—	—	—	
Dumbarton	2	18	20	—	16	
Dumfries	—	11	11	—	36	
Edinburgh	2	24	26	—	483	
Elgin	—	2	2	—	24	
Fife	2	42	44	—	143	
Forfar	—	2	2	—	211	
Haddington	—	4	4	—	12	
Inverness	—	4	4	—	57	
Kincardine	—	3	3	—	45	
Kinross	—	—	—	—	10	
Kirkcudbright	—	5	5	—	10	
Lanark	4	103	107	—	308	
Linlithgow	—	20	20	—	64	
Nairn	—	—	—	—	2	
Orkney	—	—	—	—	18	
Shetland	1	1	2	—	12	
Peebles	—	—	—	—	7	
Perth	—	10	10	—	58	
Renfrew	—	11	11	—	65	
Ross	—	1	1	—	31	
Roxburgh	—	1	1	—	34	
Selkirk	—	—	—	—	3	
Stirling	—	24	24	—	73	
Sutherland	—	—	—	—	12	
Wigtown	—	—	—	—	22	
Totals	19	398	417	—	2,287	
IRELAND.						
Antrim	2	21	23	—	170	
Armagh	—	—	—	—	51	
Carlow	—	2	2	—	12	
Cavan	—	—	—	—	14	
Clare	—	—	—	—	19	
Cork	—	8	8	—	33	
Donegal	—	6	6	—	27	
Down	—	—	—	—	76	
Dublin	—	—	—	—	27	
Carried forward	2	37	39	—	429	

Counties.	Stores.			Small Firework Factories.	Registered Premises.	Remarks.
	Under Continuing Certificate.	Under License.	Total.			
IRELAND—*cont.*						
Brought forward -	2	37	39	—	429	
Fermanagh - - -	—	2	2	—	14	
Galway - - -	—	4	4	—	20	
Kerry - - -	—	4	4	—	11	
Kildare - - -	—	—	—	—	11	
Kilkenny - - -	—	—	—	—	13	
King's County - -	—	—	—	—	16	
Leitrim - - -	—	—	—	—	7	
Limerick - - -	—	3	3	—	22	
Londonderry - - -	—	2	2	—	65	
Longford - - -	—	—	—	—	6	
Louth - -	—	—	—	—	10	
Mayo - - - -	—	2	2	—	18	
Meath - - -	—	—	—	—	11	
Monaghan - - -	—	1	1	—	18	
Queen's County - -	—	2	2	—	10	
Roscommon - - -	—	3	3	—	10	
Sligo - - -	—	—	—	—	6	
Tipperary - - -	—	4	4	—	29	
Tyrone - - -	—	2	2	—	55	
Waterford - - -	—	—	—	—	6	
Westmeath - - -	—	1	1	—	18	
Wexford - - -	—	4	4	—	16	
Wicklow - - -	—	—	—	—	12	
Totals - -	2	71	73	—	833	
SUMMARY.						
ENGLAND AND WALES - -	184	1,514	1,698	19	24,846	
SCOTLAND - - -	19	398	417	—	2,287	
IRELAND - - - -	2	71	73	—	833	
GRAND TOTALS -	205	1,983	2,188	19	27,966	

APPENDIX F.

ORDER IN COUNCIL, No. 15.

Explosives Act, 1875 (38 *Vict. c.* 17).

ORDER IN COUNCIL prohibiting FIREWORKS consisting of or containing SULPHUR in admixture with CHLORATE of POTASSIUM or other CHLORATE.

At the Court at Windsor,
The 30th day of April 1894

PRESENT:

The Queen's most Excellent Majesty in Council.

Whereas, by Part II. (section 43) of the Explosives Act, 1875, it is provided that Her Majesty from time to time, by Order in Council, may prohibit, either absolutely or except in pursuance of a license of the Secretary of State under the Act, or may subject to conditions or restrictions

the manufacture, keeping, importation from any place outside the United Kingdom, conveyance and sale, or any of them, of any explosive which is of so dangerous a character that in the judgment of Her Majesty it is expedient for the public safety to make such Order:

And whereas it is in the judgment of Her Majesty expedient for the public safety that certain fireworks which experience has shown to be liable to cause accidents should be prohibited except under certain conditions:

Now, therefore, in pursuance of the above-mentioned provisions of the Act, Her Majesty is pleased by and with the advice of Her Privy Council to order and prescribe,

That no firework as defined by an Order made under the 106th section of the Act, and in force for the time being, and which firework consists of Sulphur in admixture with Chlorate of Potassium or other Chlorates or which contains any such admixture shall be manufactured, imported, kept, conveyed or sold except with the consent of and subject to conditions approved by a Government Inspector under the Act.

Provided that this Order shall not come into force so far as concerns keeping, conveying or selling until the 1st January 1895, but so far as concerns the manufacture and importation it shall come into force at the expiration of one calendar month from the date hereof.

C. L. PEEL.

APPENDIX G.

LIST of RAILWAYS (including DOCKS working under the Railway Code) the BYELAWS of which have been confirmed, and of those Railways, &c. which refuse to carry Explosives, corrected up to 31st December 1894.

Byelaws. Whether Model Code, &c.	Name of Railway or Dock.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	ENGLAND AND WALES.					
M. C.	Barry Railway - - -	9/10/91	—	—	—	
M. C.	Bishop's Castle - - -	14/12/76	—	—	—	
M. C.	Brecon and Merthyr Tydvil Junction	30/10/76	—	—	—	
M. C.	Cambrian, including:— - -	22/3/83	—	—	—	
—	Mid Wales - - -	27/10/76	—	—	—	
M. C.	Central Wales and Carmarthen Junction.	—	—	—	—	Railway transferred to London and North Western Railway Company.
Special	Chelsea Dock - -	—	—	—	—	*See* West London Extension Railway.
M. C.	Cheshire Lines Committee -	21/10/76	—	—	—	
M. C.	Cleator and Workington Junction -	22/3/79	—	—	—	
M. C.	Cockermouth, Keswick, and Penrith	18/11/76	—	—	—	Joint property of Midland, Great Northern, and Manchester, Sheffield, and Lincolnshire Railway Companies.
M. C.	Colne Valley - - -	—	—	—	—	(*See* Great Eastern).
M. C.	Cornwall - - - -	—	—	—	—	Amalgamated with Great Western.
M. C.	Cowes and Newport - -	—	—	—	—	Now Isle of Wight Central.
M. C.	Denbigh, Ruthin, and Corwen -	—	—	—	—	Railway transferred to London and North Western Railway Company.
M. C.	East and West Junction - -	4/12/76	—	—	—	
M. C.	Eastern and Midlands - -	—	—	—	—	Joint property Midland and Great Northern Railway Companies.
M. C.	Felixstowe Railway and Pier -	—	—	—	—	Now Great Eastern.
M. C.	Festiniog - - -	10/1/77	—	—	—	
M. C.	Festiniog and Blaenau - -	—	—	—	—	Now Great Western.
M. C.	Fishguard and Rosslare - -	—	3/8/94	—	—	
M. C. Special as to Byelaw 10.	Furness - - -	3/7/91	—	—	—	
	Carried forward - -	11	1	—	—	

Byelaws. Whether Model Code, &c.	Name of Railway or Dock.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	ENGLAND AND WALES—*continued.*					
	Brought forward -	11	1	—	—	
Special	Foss River - - -	—	—	—	—	*See* Canals.
M. C.	Great Eastern, including :— -	7/12/76	—	—	—	
	Colne Valley - - -	7/12/76	—	—	—	
M. C.	Felixstowe Railway and Pier -	16/1/79	—	—	—	
M. C.	Thetford and Watton - -	4/10/76	—	—	—	
M. C.	Great Northern, including :— -	27/10/76	—	—	—	
	Stafford and Uttoxeter - -	—	—	1	—	
M. C.	Great Northern and Great Eastern Joint Committee.	10/3/82	—	—	—	
M. C.	Great Northern and London and North-Western Joint Committee.	8/9/79	—	—	—	
M. C.	Great Western, including :— -	18/1/77	—	—	—	
M. C.	Cornwall - - -	26/1/80	—	—	—	
M. C.	Blaenau and Festiniog - -	—	—	1	—	
M. C.	Monmouthshire - -	7/11/76	—	—	—	
M. C.	Torbay and Brixham - -	27/11/76	—	—	—	
Special	Grimsby Docks - - - -	—	—	—	—	*See* Manchester, Sheffield, and Lincolnshire Railway.
Special	Hartlepool Docks - -	—	—	—	—	Property of North-Eastern Railway Company.
M. C.	Hoylake and Birkenhead - -	—	—	—	—	Merged into Wirral Railway.
M. C.	Hull, Barnsley, and West Riding Junction Railway and Dock.	4/6/85	—	—	—	
M. C.	Isle of Wight - - - -	7/6/77	—	—	—	
—	Isle of Wight Central, including :—	—	—	—	—	
—	Cowes and Newport - -	7/3/77	—	—	—	
—	Ryde and Newport - -	9/2/77	—	—	—	
—	Lancashire and Yorkshire -	—	—	1	—	
M. C.	Liskeard and Caradon - -	1/8/79	—	—	—	
M. C.	London and North-Western, including :—	30/10/76	—	—	—	
M. C.	Central Wales and Carmarthen Junction.	25/10/76	—	—	—	
M. C.	Denbigh, Ruthin, and Corwen	25/1/77	—	—	—	
M. C.	London and North-Western and Rhymney Joint.	11/12/76	—	—	—	
M. C.	London and North-Western and Furness Joint, including :—	12/8/78	—	—	—	
M. C.	Whitehaven, Cleator, and Egremont.	12/10/76	—	—	—	
M. C.	London and North-Western and Midland Joint (Ashby and Nuneaton).	9/12/76	—	—	—	
M. C.	London and North-Western and Brecon and Merthyr Joint Committee.	1/9/79	—	—	—	
M. C.	London and North-Western and Great Western Joint.	27/1/77	—	—	—	
M. C.	London, Brighton, and South Coast	14/12/76	—	—	—	
M. C.	London, Chatham, and Dover -	6/2/77	—	—	—	
M. C.	London and South-Western -	30/10/76	—	—	—	
M. C.	London and St. Katherine Docks -	9/9/80	—	—	—	
M. C.	London, Tilbury, and Southend -	9/2/77	—	—	—	
M. C.	Londonderry (Seaham to Sunderland).	2/5/77	—	—	—	
M. C.	Macclesfield Committee - -	21/10/76	—	—	—	
M. C.	Manchester, Sheffield, and Lincolnshire, including :—	30/10/76	—	—	—	
M. C.	Trent, Ancholme, and Grimsby	7/12/76	—	—	—	
Special	Grimsby Docks - -	—	—	1	—	
—	Manchester, South Junction and Altrincham.	—	—	1	—	
M. C.	Manchester and Milford - -	17/1/77	—	—	—	
M. C.	Maryport and Carlisle -	10/11/76	—	—	—	
M. C.	Mawddy - - -	13/4/77	—	—	—	
—	Metropolitan - - -	—	—	1	—	
—	Metropolitan District - -	—	—	1	—	
M. C.	Midland - - - -	8/12/76	—	—	—	
	Carried forward - -	49	1	7	—	

Byelaws. Whether Model Code, &c.	Name of Railway or Dock.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	ENGLAND AND WALES—*continued.*					
	Brought forward	49	1	7	—	
M. C.	Midland and Great Northern Joint Committee, including:—	—	10/5/94	—	—	
M. C.	Eastern and Midlands	19/6/83	—	—	—	
—	Midland and South-Western Junction, including:—	—	—	—	—	
M. C.	Swindon, Marlboro', and Andover.	11/7/81	—	—	—	
M. C.	Mid-Wales	—	—	—	—	*See* Cambrian.
Special	Millwall Docks	—	—	1	—	
M. C.	Monmouthshire	—	—	—	—	Now Great Western.
Special	Middlesboro' Docks	—	—	—	—	Now North-Eastern.
M. C.	Neath and Brecon	24/10/76	—	—	—	
M. C.	North-Eastern, including:—	13/10/76	—	—	—	
Special	Middlesboro' Docks	—	—	1	—	
M. C.	Scotswood, Newburn, and Wylam	20/1/77	—	—	—	
Special	Tyne Dock	—	—	1	—	
Special	Hartlepool Docks	—	—	1	—	
Special	West Hartlepool Dock	—	—	1	—	
Special	Wearmouth Dock	—	—	1	—	
—	North London	—	—	1	—	
M. C.	North Pembrokeshire and Fishguard	—	1/6/94	—	—	
M. C.	North Staffordshire	20/9/76	—	—	—	
M. C.	Northampton and Banbury Junction	13/2/77	—	—	—	
M. C.	Oldham, Ashton-under-Lyne, and Guide Bridge Junction.	21/10/76	—	—	—	
M. C.	Pembroke and Tenby	17/1/77	—	—	—	
M. C.	Penarth (Harbour and Dock)	3/10/82	—	—	—	Lessees, Taff Railway Company.
M. C.	Potteries, Shrewsbury, and North Wales.	1/1/77	—	—	—	(Railway closed, to be acquired by Shropshire Railway Company; new undertaking.)
—	Preston and Wyre (London and North-Western and Lancashire and Yorkshire Joint).	—	—	1	—	
M. C.	Rhondda and Swansea Bay	10/2/85	—	—	—	
M. C.	Rhymney	6/10/76	—	—	—	
M. C.	Ryde and Newport	—	—	—	—	*See* Isle of Wight Central.
M. C.	Stafford and Uttoxeter	—	—	—	—	*See* Great Northern.
M. C.	Sheffield and Midland Companies Joint Committee.	7/12/76	—	—	—	
M. C.	Scotswood, Newburn, and Wylam	—	—	—	—	*See* North-Eastern.
M. C.	Severn and Wye	17/6/78	—	—	—	Amalgamated with Severn Bridge.
M. C.	South-Eastern	28/2/77	—	—	—	
M. C.	Southport and Cheshire Lines Extn.	26/6/84	—	—	—	
M. C.	Swindon, Marlboro', and Andover	—	—	—	—	*See* Midland and South-Western Junction.
M. C.	Taff Vale	30/9/76	—	—	—	
M. C.	Tallylyn	20/1/77	—	—	—	
M. C.	Thetford and Watton	—	—	—	—	*See* Great Eastern.
M. C.	Torbay and Brixham	—	—	—	—	*See* Great Western.
M. C.	Trent, Ancholme, and Grimsby	—	—	—	—	*See* Manchester, Sheffield, and Lincolnshire Railway.
Special	Tyne Dock	—	—	—	—	*See* North-Eastern Railway.
M. C.	Vale of Towy Joint Railway	27/1/92	—	—	—	London and North-Western and Great Western.
M. C.	Van	3/3/77	—	—	—	
M. C.	West London Extension, including:—	8/12/76	—	—	—	Property of London and North-Western, Great Western, London, Brighton, and South Coast, and London and South-Western Railway Companies.
	Chelsea Dock	—	—	1	—	
Special	West Hartlepool Dock	—	—	—	—	*See* North-Eastern Railway.
M. C.	West Somerset (Mineral)	8/12/76	—	—	—	
M. C.	Whitehaven, Cleator, and Egremont	—	—	—	—	*See* London and North-Western and Furness Joint.
M. C.	Wrexham, Mold, and Connah's Quay.	5/11/87	—	—	—	
M. C.	Wirral Railway, including	6/12 80	—	—	—	
—	Hoylake and Birkenhead	6/12/80	—	—	—	
	Total	75	3	16	—	

RAILWAYS (including DOCKS working under the Railway Code) the BYELAWS of which have been confirmed, and of those Railways, &c. which refuse to carry Explosives, up to 31st December 1894.

Byelaws. Whether Model Code, &c.	Name of Railway or Dock.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	SCOTLAND.					
—	Ayrton and Wigtonshire	—	—	—	—	(*See* Glasgow and South-Western).
M. C.	Anstruther and St. Andrews	9/7/84	—	—	—	
M. C.	Caledonian	30/10/76	—	—	—	
M. C.	City of Glasgow Union	30/10/76	—	—	—	
M. C.	Dundee and Arbroath Joint Committee.	17/10/81	—	—	—	
M. C.	Girvan and Portpatrick	20/8/77	—	—	—	
M. C.	Glasgow and South-Western	30/10/76	—	—	—	
M. C.	Glasgow, Barrhead, and Kilmarnock Joint.	30/10/76	—	—	—	
M. C.	Glasgow and Paisley Joint	30/10/76	—	—	—	Worked by North British.
M. C.	Glasgow, Yoker, and Clydebank	12/5/84	—	—	—	
M. C.	Great North of Scotland	4/10/76	—	—	—	
M. C.	Glasgow City and District	8/1/86	—	—	—	
M. C.	Highland	22/1/77	—	—	—	
M. C.	Kelvin Valley	—	—	—	—	*See* North British.
M. C.	Killin	25/3/92	—	—	—	
M. C.	Kilsyth and Bonnybridge	22/9/88	—	—	—	
M. C.	North British, including:—	30/10/76	—	—	—	
M. C.	Kelvin Valley	16/8/84	—	—	—	
M. C.	Strathendrick and Aberfoyle	27/6/84	—	—	—	
M. C.	Portpatrick and Wigtownshire Joint Committee, including:—	12/8/86	—	—	—	
	Wigtownshire	20/1/77	—	—	—	
	Total	19	—	—	—	
	IRELAND.					
M. C.	Ballycastle	6/8/80	—	—	—	
M. C.	Belfast and County Down, including—	12/3/77	—	—	—	
M. C.	Downpatrick, Dundrum, and Newcastle.	17/4/77	—	—	—	
M. C.	Belfast and Northern Counties, including:—	2/2/77	—	—	—	
M. C.	Ballymena and Larne	17/6/78	—	—	—	
M. C.	Carrickfergus and Larne	10/2/77	—	—	—	
M. C.	Cavan, Leitrim, and Roscommon Light Railway and Tramway.	—	31/3/94	—	—	
M. C.	Cork, Bandon, and South Coast Rly.	—	27/4/94	—	—	
—	Clogher Valley Light Railway or Tramway.	—	—	—	—	
M. C.	Draperstown	21/12/83	—	—	—	Worked by Belfast and Northern Counties.
M. C.	Dublin, Wicklow, and Wexford	26/3/77	—	—	—	
M. C.	Dundalk, Newry, and Greenore	9/5/77	—	—	—	Property of London and North-Western.
M. C.	Derry Central	27/5/80	—	—	—	Worked by Belfast and Northern Counties.
M. C.	Donegal, including:—	—	3/1/94	—	—	
M. C.	Finn Valley	26/3/77	—	—	—	
M. C.	West Donegal	26/10/82	—	—	—	
M. C.	Fishguard and Rosslare	—	3/8/94	—	—	
M. C.	Great Northern of Ireland	26/3/77	—	—	—	
M. C.	Great Southern and Western, including:—	10/2/77	—	—	—	
M. C.	Kanturk and Newmarket	21/5/89	—	—	—	
M. C.	Listowel and Ballybunnion	20/2/88	—	—	—	
M. C.	Limavady and Dungiven	12/3/84	—	—	—	
M. C.	Midland Great Western	13/3/77	—	—	—	
M. C.	Sligo, Leitrim, and Northern Counties	—	8/5/94	—	—	
M. C.	Tralee and Dingle Light Railway or Tramway.	8/10/90	—	—	—	
M. C.	Waterford and Tramore	—	—	1	—	
M. C.	Waterford and Central Ireland	5/1/77	—	—	—	
M. C.	Waterford and Limerick, including—	2/2/77	—	—	—	
M. C.	Athenry and Ennis Junction	5/3/77	—	—	—	
M. C.	Athenry and Tuam	5/3/77	—	—	—	
M. C.	Rathkeale and Newcastle Junction	5/3/77	—	—	—	
M. C.	West Donegal	—	—	—	—	Now Donegal.
M. C.	West Clare	27/4/87	—	—	—	
	Total	25	5	1	—	

SUMMARY.

	Byelaws made regulating General Traffic.		Explosives not carried.		Total Number of Railways provided for.	Remarks.
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.		
ENGLAND AND WALES - -	75	3	16	—	94	
SCOTLAND - - - -	19	—	—	—	19	
IRELAND - - -	25	5	1	—	31	
Total - - -	119	8	17	—	144	

APPENDIX H.

CANAL COMPANIES, the BYELAWS of which have been confirmed, and Companies which decline to carry Explosives, up to 31st December 1894.

Byelaws. Whether Model Code, &c.	Name of Canal, &c.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	ENGLAND AND WALES.					
M. C.	Aberdare Canal - - -	5/8/76	—	—	—	
M. C.	Aire and Calder Navigation -	7/11/76	—	—	—	Including the Port of Goole.
M. C.	Ancholme Drainage and Navigation	30/10/76	—	—	—	
M. C.	Ashton-under-Lyne Canal - -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
—	Avon River - - - -	—	—	1	—	
M. C.	Arun Navigation - - -	18/12/77	—	—	—	
M. C.	Ashby-de-la-Zouche Canal - -	2/7/77	—	—	—	Property of Midland Railway Company.
—	Barnsley Canal - - -	—	—	—	—	Included in Aire and Calder Navigation Company, to whom it has been conveyed under power given by Act of Parliament.
M. C.	Birmingham Canal Navigation -	21/12/76	—	—	—	
M. C.	Bridgewater Navigation, Limited -	21/6/76	—	—	—	Including Runcorn Harbour.
—	Bude Canal - - - -	—	—	1	—	
M. C.	Beverley Beck - - -	7/7/76	—	—	—	
—	Bure, Yare, and Waveney Rivers -	—	—	—	—	Included in byelaws made by Great Yarmouth Port and Haven Commissioners.
M. C.	Birmingham and Liverpool Junction Canal.	21/4/77	—	—	—	Property of Shropshire Union Railway Company.
M. C.	Brecon and Abergavenny Canal -	17/1/77	—	—	—	Property of Great Western Railway Company.
M. C.	Bridgewater and Taunton Canal -	11/4/77	—	—	—	
M. C.	Bradford Canal - - -	18/8/80	—	—	—	
M. C.	Calder and Hebble Navigation -	17/9/76	—	—	—	
M. C.	Chelmer and Blackwater Navigation	4/7/76	—	—	—	
M. C.	Chesterfield Canal - - -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
M. C.	Coventry Canal - - -	23/2/77	—	—	—	
	Carried forward - -	17	—	2	—	

Byelaws. Whether Model Code, &c.	Name of Canal, &c.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	ENGLAND AND WALES—*continued.*					
	Brought forward - -	17	—	2	—	
M. C.	Cromford Canal - -	2/7/77	—	—	—	
M. C.	Chester Canal - - -	21/4/77	—	—	—	Property of Shropshire Union Railway Company.
M. C.	Dear and Dove Canal - -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
—	Driffield Canal - - -	—	—	1	—	
M. C.	Droitwich Canal - - -	22/6/76	—	—	—	Property of Sharpness New Docks and Birmingham Navigation Company.
M. C.	Droitwich Junction Canal - -	22/6/76	—	—	—	
M. C.	Dun River Navigation - -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
M. C.	Derby Canal - - -	21/4/77	—	—	—	
M. C.	Derwent River - - -	13/8/77	—	—	—	
M. C.	Erewash Canal - - -	8/7/76	—	—	—	
M. C.	Exe River and Exeter Canal (Exeter Canal, and within that portion of the Port of Exeter situate within the Cheekstone Rock, except such portions thereof as are included within the prescribed limits of the Exe Bight Pier Company and the Exmouth Dock Company.)	1/8/76	—	—	—	
M. C.	Ellesmere and Chester Canal - -	21/4/77	—	—	—	Property of Shropshire Union Railway.
Special	Foss River - - - -	27/8/88	—	—	—	
M. C.	Fossdyke Navigation - - -	27/10/76	—	—	—	Property of Great Northern Railway Company.
—	Gipping River - - - -	—	—	—	—	Property of Great Eastern Railway Company. Included in Stowmarket Navigation.
M. C.	Glamorganshire Canal Navigation -	25/7/89	—	—	—	
M. C.	Gloucester and Berkeley Canal -	22/6/76	—	—	—	Property of Sharpness New Dock and Birmingham Navigation Company.
—	Grand Surrey Canal - - -	—	—	1	—	Included in Surrey Commercial Dock Company, who absolutely prohibit the introduction of explosives.
M. C.	Grand Union Canal - - -	28/6/76	—	—	—	
M. C.	Grantham Canal - - - -	27/10/76	—	—	—	Property of Great Northern Railway Company.
M. C.*	Grand Junction Canal - - -	15/12/79	—	—	—	*Model code, but a special clause (12) was added prohibiting the master of any boat carrying explosive from entering any tunnel without giving notice to the captain of the Company's tugs at Blisworth and Braunston respectively, and from passing into either of those tunnels at a less distance than 500 yards from the last boat in tow of any steam tug.
M. C.	Grand Western Canal - - -	11/4/77	—	—	—	
	Carried forward - -	36	—	4	—	

Byelaws. Whether Model Code, &c.	Name of Canal, &c.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	ENGLAND AND WALES—*continued.*					
	Brought forward - -	36	—	4	—	
M. C.	Hereford and Gloucester Canal -	11/4/77	—	—	—	Property of Great Western Railway Company.
—	Horncastle Navigation - -	—	—	1	—	
M. C.	Huddersfield and Manchester Canal	24/6/76	—	—	—	Property of London and North-Western Railway Company.
M. C.	Kennet and Avon Canal (including River Avon from Bath to Hanham Mills).	11/4/77	—	—	—	Property of Great Western Railway Company.
M. C.	Knutbrook Canal - - - -	25/9/76	—	—	—	
M. C.	Lancaster Canal - - -	24/6/76	—	—	—	Property of London and North-Western Railway Company.
M. C.	Leeds and Liverpool Canal (the Leeds and Liverpool Canal, the Leigh branch thereof, the South Level of the Lancaster Canal and the Douglas Navigation).	13/11/76	—	—	—	
M. C.	Leicester Navigation - - -	8/7/76	—	—	—	
M. C.	Leicestershire and Northampton Union Canal.	21/6/76	—	—	—	
—	Leven Canal - - -	—	—	1	—	
M. C.	Loughborough Navigation - -	8/7/76	—	—	—	
—	Lee River - - -	—	—	—	—	All explosives conveyed in Government barges.
M. C.	Louth Canal - - - -	18/9/77	—	—	—	
M. C.	Middle Level Navigation - - -	14/12/76	—	—	—	
M. C.	Macclesfield Canal - - -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
M. C.	Manchester, Bolton, and Bury Canal	23/3/78	—	—	—	Property of Lancashire and Yorkshire Railway Company.
M. C.	Market Weighton Canal - -	30/10/77	—	—	—	Property of North-Eastern Railway Company.
M. C.	Medway Navigation - -	5/2/77	—	—	—	
M. C.	Mersey and Irwell Navigation -	1/9/77	—	—	—	Property of Bridgwater Navigation Company, Limited.
M. C.	Monmouthshire Canal - -	11/4/77	—	—	—	Property of Great Western Railway Company.
M. C.	Montgomeryshire Canal - -	21/4/77	—	—	—	Property of Shropshire Union Railway Company.
M. C.	Newark Navigation - - - -	8/12/76	—	—	—	
M. C.	Neath Canal - - - -	28/9/76	—	—	—	
M. C.	Nene Valley Drainage and Navigation (2nd District).	19/8/76	—	—	—	
M. C.	Nene Navigation (3rd District) -	20/12/76	—	—	—	
—	North Walsham and Dilham Canal	—	—	1	—	
M. C.	Nottingham and Grantham Canal -	27/10/76	—	—	—	Property of Great Northern Railway Company.
M. C.	Nutbrook Canal - - -	25/9/76	—	—	—	
M. C.	Newcastle-under-Lyne Canal -	10/8/77	—	—	—	Property of North Staffordshire Railway Company.
M. C.	North Wilts Canal - -	—	—	—	—	Included in Wilts and Berks Canal.
M. C.	Norwich and Lowestoft Navigation and Haddiscoe Cut.	1/2/77	—	—	—	Property of Great Eastern Railway Company.
M. C.	Old Chester Canal - -	21/4/77	—	—	—	Property of Shropshire Union Railway Company.
M. C.	Oxford Canal - -	12/9/77	—	—	—	
	Carried forward - -	64	—	7	—	

Byelaws. Whether Model Code, &c.	Name of Canal, &c.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	ENGLAND AND WALES—*continued.*					
	Brought forward - -	64	—	7	—	
—	Ouse River, Sussex - - -	—	—	—	—	Included in Newhaven Harbour.
M. C.	Ouse River, York - - -	8/12/77	—	—	—	York Corporation Conservators and Trustees.
M. C.	Peak Forest Canal - -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
—	Portsmouth and Arundel Canal -	—	—	1	—	
M. C.	Pocklington Canal - -	30/10/77	—	—	—	Property of North-Eastern Railway Company.
M. C.*	Regent's Canal (including Hertford Union Canal, Limehouse Basin, and the City Road Basin).	17/1/77	—	—	—	* Addition to Bye Law No. 9.
M. C.	Rochdale Canal - - -	16/1/77	—	—	—	
M. C.	Ramsden's (Sir John) Canal - -	24/6/76	—	—	—	Property of London and North-Western Railway Company.
M. C.	St. Helen's Canal - - -	24/6/76	—	—	—	Property of London and North-Western Railway Company.
M. C.	Sharpness New Docks - -	22/6/76	—	—	—	
M. C.	Sheffield Canal - - -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
M. C.	Severn and Wye and Severn Bridge Railway Company's Navigation and Wharves.	14/11/85	—	—	—	
M. C.	Severn Navigation Company - -	23/5/76	—	—	—	
—	Sleaford Navigation - -	—	—	1	—	
M. C.	Staffordshire and Worcestershire Canal.	7/6/76	—	—	—	
M. C.	Stainforth and Keadby Canal -	13/11/76	—	—	—	Property of Manchester, Sheffield, and Lincolnshire Railway Company.
M. C.	Stowmarket and Ipswich Navigation	7/12/76	—	—	—	Property of Great Eastern Railway Company.
M. C.	Stover Canal - - -	11/4/77	—	—	—	Property of Great Western Railway Company.
M. C.	Swansea Canal - -	11/4/77	—	—	—	
M. C.	Shrewsbury Canal - -	21/4/77	—	—	—	Property of Shropshire Union Railway Company.
M. C.	Stourbridge Canal - -	21/7/76	—	—	—	
M. C.	Stourbridge Extension Canal -	11/4/77	—	—	—	Property of Great Western Railway Company.
M. C.	Stort River - - -	14/8/77	—	—	—	
M. C.	Stroudwater Navigation - -	8/12/76	—	—	—	
M. C.	Stratford-upon-Avon Canal -	11/4/77	—	—	—	Property of Great Western Railway Company.
M. C.	Thames and Severn Canal - -	4/7/76	—	—	—	
M. C.	Trent River - - - -	7/12/76	—	—	—	
M. C.	Trent and Mersey Canal - -	10/8/77	—	—	—	Property of North Staffordshire Railway Company.
M. C.	Tennant Canal - - -	31/1/77	—	—	—	
M. C.	Ure River - - -	30/10/77	—	—	—	North-Eastern Railway Company.
M. C. Slight modification.	Ulverstone Canal - - -	14/12/76	—	—	—	Property of Furness Railway Company.
M. C.	Weaver River Navigation - -	8/10/81	—	—	—	
M. C.	Wisbech Canal - - -	5/8/76	—	—	—	
M. C.	Witham River - - -	27/10/76	—	—	—	Property of Great Northern Railway Company.
M. C.	Worcester and Birmingham Navigation.	22/6/76	—	—	—	Property of Sharpness New Docks and Birmingham Navigation Company.
M. C.	Wilts and Berks Canal - -	10/1/77	—	—	—	
	Total - - -	97	—	9	—	

LIST of CANAL COMPANIES the BYELAWS of which have been CONFIRMED, and of the Companies which decline to carry Explosives, up to 31st December 1894.

Byelaws. Whether Model Code, &c.	Name of Canal, &c.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	SCOTLAND.					
M. C. Slight modification.	Caledonian Canal, including :— Crinan Canal.	22/12/76	—	—	—	
—	Edinburgh and Glasgow Union Canal	—	—	1	—	Property of North British Railway Company.
M. C. Slight modification.	Forth and Clyde Canal, including :— Monkland Canal.	11/5/77	—	—	—	Included in Forth and Clyde Canals and Caledonian Railway Company.
M. C.	Glasgow, Paisley, and Johnstone	10/6/76	—	—	—	Property of Glasgow and South-Western Railway Company.
	Total	3	—	1	—	

LIST of CANAL COMPANIES the BYELAWS of which have been CONFIRMED, and of Companies which decline to carry Explosives, to 31st December 1894.

Byelaws. Whether Model Code, &c.	Name of Canal, &c.	Date of Sanction of Byelaws.		Explosives not carried.		Remarks.
		Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	
	IRELAND.					
—	Barrow Navigation	—	—	1	—	
M. C.	Grand Canal	11/8/76	—	—	—	
M. C.	Lagan Navigation	13/12/76	—	—	—	
M. C.	Newry Navigation	8/9/76	—	—	—	
M. C.	Royal Canal	21/9/76	—	—	—	Midland Great Western Railway Company of Ireland.
—	Lower Boyne Navigation	18/9/78	—	—	—	Property of the Commissioners of Public Works in Ireland.
M. C.	Margui Navigation	12/9/78	—	—	—	
M. C.	Shannon Navigation	12/9/78	—	—	—	
M. C.	Tyrone Navigation	12/9/78	—	—	—	
M. C.	Ulster Canal	12/9/78	—	—	—	
	Total	9	—	1	—	

SUMMARY.

	Byelaws made regulating General Traffic.		Explosives not carried.		Total Number of Canals provided for.	Remarks.
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.		
ENGLAND AND WALES	97	—	9	—	106	
SCOTLAND	3	—	1	—	4	
IRELAND	9	—	1	—	10	
TOTAL	109	—	11	—	120	

APPENDIX I.

HARBOURS and DOCKS for which BYELAWS have been made, and HARBOURS and DOCKS in which the TRAFFIC in EXPLOSIVES has been prohibited, up to 31st December 1894.

Place.	Under Explosives Act.						Where either (*a*) no Trade in Explosives exists; or (*b*) where such Traffic has been prohibited by Powers other than the Explosives Act.	
	Byelaws made regulating General Traffic.		Byelaws made limiting Traffic to 30 lbs.		Byelaws made prohibiting Traffic.			
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.
ENGLAND AND WALES.								
Aberdovey*	1	—	—	—	—	—	—	—
Aberystwith	1	—	—	—	—	—	—	—
Alexandra Docks (Hull)†	1	—	—	—	—	—	—	—
Amlwch	1	—	—	—	—	—	—	—
Arundel	1	—	—	—	—	—	—	—
Barrow Docks and Harbour*	1	—	—	—	—	—	—	—
Barmouth	1	—	—	—	—	—	—	—
Blakeney and Clay	—	—	—	—	—	—	1	—
Blyth Harbour and Docks	1	—	—	—	—	—	—	—
Birkenhead (*see* Mersey)	—	—	—	—	—	—	—	—
Boston	—	—	—	—	1	—	—	—
Bridport	1	—	—	—	—	—	—	—
Bristol*	1	—	—	—	—	—	—	—
Bridgwater	1	—	—	—	—	—	—	—
Bridlington	1	—	—	—	—	—	—	—
Broadstairs	—	—	—	—	1	—	—	—
Bude Haven	—	—	—	—	—	—	1	—
Burry Navigation (*see also* Llanelly)	—	—	—	—	1	—	—	—
Cardiff (and Bute Docks)	—	—	—	—	—	—	1	—
Carnarvon	1	—	—	—	—	—	—	—
Cattewater	1	—	—	—	—	—	—	—
Chepstow	—	—	—	—	1	—	—	—
Clovelly	—	—	—	—	1	—	—	—
Cowes (Isle of Wight)	1	—	—	—	—	—	—	—
Conway Harbour*	1	—	—	—	—	—	—	—
Conway River (outside Harbour Commissioners' jurisdiction).	—	—	—	—	1	—	—	—
Colchester	1	—	—	—	—	—	—	—
Colne (*see* Colchester)	—	—	—	—	—	—	—	—
Combmartin	—	—	—	—	1	—	—	—
Dartmouth	1	—	—	—	—	—	—	—
Dover Harbour	—	—	1	—	—	—	—	—
Dover (Government Pier)	—	—	—	—	1	—	—	—
Devonport (*see also* Hamoaze)	1	—	—	—	—	—	—	—
East and West India Docks	—	—	—	—	1	—	—	—
Exeter and Exmouth	1	—	—	—	—	—	—	—
Falmouth	1	—	—	—	—	—	—	—
Fareham (included in Portsmouth)	—	—	—	—	—	—	—	—
Faversham	1	—	—	—	—	—	—	—
Fleetwood	—	—	—	—	1	—	—	—
Foss River‡	—	—	—	—	—	—	—	—
Fowey	1	—	—	—	—	—	—	—
Carried forward	23	—	1	—	10	—	3	—

* Approved by Customs. † *See also* Hull Docks. ‡ *See* Appendix G.

Place.	Under Explosives Act.						Where either (*a*) no Trade in Explosives exists; or (*b*) where such Traffic has been prohibited by Powers other than the Explosives Act.	
	Byelaws made regulating General Traffic.		Byelaws made limiting Traffic to 30 lbs.		Byelaws made prohibiting Traffic.			
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.
ENGLAND AND WALES—*cont.*								
Brought forward	23	—	1	—	10	—	3	—
Garston Dock	1	—	—	—	—	—	—	—
Goole*	1	—	—	—	—	—	—	—
Great Western Docks (Plymouth)	1	—	—	—	—	—	—	—
Gosport (included in Portsmouth)	—	—	—	—	—	—	—	—
Great Yarmouth	1	—	—	—	—	—	—	—
Grimsby Docks†	—	—	—	—	—	—	—	—
Hamoaze	1	—	—	—	—	—	—	—
Hartlepool Docks†	—	—	—	—	—	—	—	—
Hartlepool	—	—	—	—	1	—	—	—
Hayle (Lelant Quays)	—	—	—	—	—	—	1	—
Hayle Port	1	—	—	—	—	—	—	—
Harwich	1	—	—	—	—	—	—	—
Holyhead	—	—	—	—	1	—	—	—
Hull Docks (Kingston)*	1‡	—	—	—	—	—	—	—
Hull (Old Harbour)	—	—	—	—	1	—	—	—
Humber*	1	—	—	—	—	—	—	—
Ilfracombe	1	—	—	—	—	—	—	—
Ipswich	1	—	—	—	—	—	—	—
Kidwelly	—	—	—	—	—	—	1	—
King's Lynn*	1	—	—	—	—	—	—	—
Laugharne (*see* Taff)	—	—	—	—	—	—	—	—
Lancaster	—	—	—	—	—	—	1	—
Littlehampton	1	—	—	—	—	—	—	—
Liverpool*	1	—	—	—	—	—	—	—
Llanelly (*see* Burry)	—	—	—	—	—	—	—	—
London and St. Katherine Docks†	—	—	—	—	—	—	—	—
Looe	—	—	—	—	—	—	1	—
Lowestoft	1	—	—	—	—	—	—	—
Lymington River	1	—	—	—	—	—	—	—
Lymington Harbour	1	—	—	—	—	—	—	—
Llanerchymor	1§	—	—	—	—	—	—	—
Llandulas Pier	1	—	—	—	—	—	—	—
Margate	—	—	1	—	—	—	—	—
Maryport	—	—	—	—	1	—	—	—
Menai Bridge Pier	—	—	—	—	—	—	1	—
Medway	1	—	—	—	—	—	—	—
Mersey, Upper*§	1	—	—	—	—	—	—	—
Mersey, Lower*	1	—	—	—	—	—	—	—
Milford Haven	1	—	—	—	—	—	—	—
Millwall Docks	—	—	—	—	—†	—	—	—
Middlesboro' Docks†	—	—	—	—	—	—	—	—
Minehead	1	—	—	—	—	—	—	—
Mousehole	—	—	—	—	—	—	1	—
Neath	1	—	—	—	—	—	—	—
Newhaven	—	—	1	—	—	—	—	—
Newport (Isle of Wight)	1	—	—	—	—	—	—	—
Carried forward	49	—	3	—	14	—	9	—

* Approved by Customs.
‡ Amorces or toy caps only.
† *See* Appendix G.
§ Additional byelaws sanctioned during 1894.

Place.	Under Explosives Act.						Where either (*a*) no Trade in Explosives exists; or (*b*) where such Traffic has been prohibited by Powers other than the Explosives Act.	
	Byelaws made regulating General Traffic.		Byelaws made limiting Traffic to 30 lbs.		Byelaws made prohibiting Traffic.			
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.
ENGLAND AND WALES—*cont.*								
Brought forward	49	—	3	—	14	—	9	—
Newport (Mon.)*	1	—	—	—	—	—	—	—
New Quay (Cardigan)	—	—	—	—	—	—	1	—
New Quay (Cornwall)	1	—	—	—	—	—	—	—
North Sunderland	—	—	—	—	—	—	1	—
Orford Haven and River Ore	—	—	—	—	1	—	—	—
Pembrey*	1	—	—	—	—	—	—	—
Penryn*	1	—	—	—	—	—	—	—
Plymouth*	1	—	—	—	—	—	—	—
Poole	1	—	—	—	—	—	—	—
Porthleven	1	—	—	—	—	—	—	—
Portsmouth (including Fareham and Gosport).*	1	—	—	—	—	—	—	—
Penzance*	1	—	—	—	—	—	—	—
Portishead Docks	1	—	—	—	—	—	—	—
Portland	1	—	—	—	—	—	—	—
Portmadoc*	1	—	—	—	—	—	—	—
Penarth*	1	—	—	—	—	—	—	—
Preston	—	1	—	—	—	—	—	—
Queenborough	1	—	—	—	—	—	—	—
Ramsgate	—	—	1	—	—	—	—	—
Runcorn	1	—	—	—	—	—	—	—
Rye	—	—	1	—	—	—	—	—
Rochester	1	—	—	—	—	—	—	—
Saundersfoot	1	—	—	—	—	—	—	—
Scarborough	1	—	—	—	—	—	—	—
Sharpness New Docks†	—	—	—	—	—	—	—	—
Shoreham (New)	1	—	—	—	—	—	—	—
Silloth	—	—	—	—	1	—	—	—
Southampton (Pier and Harbour)*	1	—	—	—	—	—	—	—
Southwold	—	—	—	—	—	—	1	—
Spalding	—	—	—	—	—	—	1	—
Sunderland	—	—	—	—	1	—	—	—
Sutton	1	—	—	—	—	—	—	—
Swansea	1	—	—	—	—	—	—	—
Surrey Commercial Dock	—	—	—	—	1	—	—	—
Taff River	—	—	—	—	1	—	—	—
Tees	1	—	—	—	—	—	—	—
Teignmouth	1	—	—	—	—	—	—	—
Tetney Haven	—	—	—	—	—	—	1	—
Thames*	1	—	—	—	—	—	—	—
Truro	1	—	—	—	—	—	—	—
Tyne (Port)*	1	—	—	—	—	—	—	—
Tyne Dock†	—	—	—	—	—	—	—	—
Watchet	1	—	—	—	—	—	—	—
Wearmouth Dock†	—	—	—	—	—	—	—	—
Weston-super-Mare	—	—	—	—	—	—	1	—
West Hartlepool Dock†	—	—	—	—	—	—	—	—
Whitby	1	—	—	—	—	—	—	—
Widnes Dock	—	—	—	—	1	—	—	—
Wisbech	1	—	—	—	—	—	—	—
Whitehaven*	1	—	—	—	—	—	—	—
Workington	—	—	—	—	1	—	—	—
Total	80	1	5	—	21	—	15	—

* Approved by Customs. † *See* Appendix G.

HARBOURS and DOCKS for which BYELAWS have been made, and HARBOURS and DOCKS in which the TRAFFIC in EXPLOSIVES has been prohibited, up to 31st December 1894.

Place.	Under Explosives Act.						Where either (*a*) no Trade in Explosives exists; or (*b*) where such Traffic has been prohibited by Powers other than the Explosives Act.	
	Byelaws made regulating General Traffic.		Byelaws made limiting Traffic to 30 lbs.		Byelaws made prohibiting Traffic.			
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.
SCOTLAND.								
Aberdeen	1	—	—	—	—	—	—	—
Aberdour	—	—	—	—	—	—	1	—
Anstruther	—	—	—	—	1	—	—	—
Arbroath	—	—	—	—	1	—	—	—
Ardrossan	1	—	—	—	—	—	—	—
Ayr	1	—	—	—	—	—	—	—
Balmerino	—	—	—	—	1	—	—	—
Banff	—	—	—	—	1	—	—	—
Blackpots	—	—	—	—	1	—	—	—
Boddam	—	—	—	—	1	—	—	—
Borrowstoneness	—	—	—	—	1	—	—	—
Bowling Bay Wharf	—	—	—	—	—	—	1	—
Bowling, West (*see* Glasgow)	—	—	—	—	—	—	—	—
Broughty Ferry	—	—	—	—	1	—	—	—
Brora	—	—	—	—	—	—	1	—
Buckhaven	—	—	—	—	1	—	—	—
Burghead	—	—	—	—	1	—	—	—
Burntisland*	1	—	—	—	—	—	—	—
Cart Navigation	1	—	—	—	—	—	—	—
Castlehill	—	—	—	—	—	—	1	—
Charlestown	—	—	—	—	1	—	—	—
Clyde*	1	—	—	—	—	—	—	—
Crail	—	—	—	—	1	—	—	—
Cullen	—	—	—	—	1	—	—	—
Dalbeattie	—	—	—	—	—	—	1	—
Drumore	—	—	—	—	—	—	1	—
Dundee	—	—	1	—	—	—	—	—
Dysart	—	—	—	—	1	—	—	—
Eday Pier and Harbour (*see* Holm St. Mary's).	—	—	—	—	—	—	—	—
Elgin and Lossiemouth	1	—	—	—	—	—	—	—
Fisherrow	—	—	—	—	—	—	1	—
Fort William	—	—	1	—	—	—	—	—
Fraserburgh	—	—	—	—	1	—	—	—
Frisky Wharf	1†	—	—	—	—	—	—	—
Forth and Clyde Navigation (including Bowling Harbour and Harbour and Docks of Grangemouth).	—	—	—	—	—	—	1	—
Forth Navigation. (For that part of the river Forth situated between Alloa and Stirling.)	—	—	—	—	1	—	—	—
Findochty	—	—	—	—	1	—	—	—
Garmouth	—	—	—	—	1	—	—	—
Gatehouse or Port McAdam	—	—	—	—	1	—	—	—
Girvan	—	—	—	—	1	—	—	—
Glasgow (*see* Clyde)*	—	—	—	—	—	—	—	—
Greenock (*see* Clyde)	—	—	—	—	—	—	—	—
Gourdan	—	—	—	—	—	—	1	—
Guardbridge	—	—	—	—	—	—	1	—
Grangemouth* (*see* Forth and Clyde Navigation).	—	—	—	—	—	—	—	—
Granton	—	—	—	—	1	—	—	—
Carried forward	8	—	2	—	21	—	10	—

* Approved by Customs.

† Regulating traffic in *gunpowder* only. There are other byelaws prohibiting traffic in explosives other than gunpowder.

Place.	Under Explosives Act.						Where either (*a*) no Trade in Explosives exists; or (*b*) where such Traffic has been prohibited by Powers other than the Explosives Act.	
	Byelaws made regulating General Traffic.		Byelaws made limiting Traffic to 30 lbs.		Byelaws made prohibiting Traffic.			
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.
SCOTLAND—*cont.*								
Brought forward	8	—	2	—	21	—	10	—
Helmsdale	—	—	—	—	—	—	1	—
Holm (St. Mary's) Pier and Harbour	1	—	—	—	—	—	—	—
Irvine*	1	—	—	—	—	—	—	—
Invergordon	1	—	—	—	—	—	—	—
Inverness	—	—	1	—	—	—	—	—
Kingsbarns	—	—	—	—	—	—	1	—
Kingston (*see also* Garmouth)	—	—	—	—	1	—	—	—
Kirkcaldy	1	—	—	—	—	—	—	—
Kirkcudbright	—	—	—	—	1	—	—	—
Kirkwall	1	—	—	—	—	—	—	—
Lamlash Bay	—	1	—	—	—	—	—	—
Largo	—	—	—	—	1	—	—	—
Largs	—	—	—	—	—	—	1	—
Leith*	1	—	—	—	—	—	—	—
Little Ferry	—	—	1	—	—	—	—	—
Lybster	—	—	1	—	—	—	—	—
Macduff	—	—	—	—	1	—	—	—
Methill	—	—	—	—	1	—	—	—
Montrose	—	—	—	—	—	—	1	—
Morrisonshaven	—	—	—	—	1	—	—	—
Newbiggin	—	—	—	—	—	—	1	—
Newburgh Shore	—	—	—	—	—	—	1	—
Newport (near Dundee)	—	—	—	—	—	—	1	—
Pittenweem	—	—	—	—	1	—	—	—
Port Edgar	—	—	—	—	1	—	—	—
Port Gordon	—	—	—	—	1	—	—	—
Port Logan	—	—	—	—	—	—	1	—
Port McAdam (*see also* Gatehouse)	—	—	—	—	1	—	—	—
Pulteney (Wick)	1	—	—	—	—	—	—	—
Pettycur	—	—	—	—	1	—	—	—
Portmahomack	1	—	—	—	—	—	—	—
Portsoy	—	—	—	—	1	—	—	—
Peterhead	1	—	—	—	—	—	—	—
Queensferry North (Piers)	—	—	—	—	1	—	—	—
Queensferry South (Piers)	—	—	—	—	1	—	—	—
Rosehearty	—	—	—	—	1	—	—	—
Scapa Pier and Harbour (*see* Holm St. Mary's).	—	—	—	—	—	—	—	—
Stornoway	1	—	—	—	—	—	—	—
St. David's	—	—	—	—	1	—	—	—
Sanday Pier	1	—	—	—	—	—	—	—
Sandhaven	—	—	—	—	1	—	—	—
South Alloa	1	—	—	—	—	—	—	—
Stairhaven	—	—	—	—	—	—	1	—
Starlyburn	—	—	—	—	—	—	1	—
Tayport	—	—	—	—	1	—	—	—
Troon	—	—	—	—	1	—	—	—
West Wemyss	—	—	—	—	1	—	—	—
Whitehills	—	—	—	—	1	—	—	—
Woodhaven	—	—	—	—	—	—	1	—
Total	20	1	5	—	42	—	21	—

* Approved by Customs.

HARBOURS and DOCKS for which BYELAWS have been made, and HARBOURS and DOCKS in which the TRAFFIC in EXPLOSIVES has been prohibited, up to 31st December 1894.

Place.	Under Explosives Act.						Where either (*a*) no Trade in Explosives exists; or (*b*) where such Traffic has been prohibited by Powers other than the Explosives Act.	
	Byelaws made regulating General Trade.		Byelaws made limiting Traffic.		Byelaws made prohibiting Traffic.			
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.
IRELAND.								
Annalong	1	—	—	—	—	—	—	—
Ardglass	—	—	—	—	1	—	—	—
Arklow	1	—	—	—	—	—	—	—
Ballywalter	1	—	—	—	—	—	—	—
Ballintoy	—	—	—	—	—	—	1	—
Bangor (County Down)	—	—	—	—	1	—	—	—
Belfast*	1	—	—	—	—	—	—	—
Burton Port	—	—	—	—	—	—	1	—
Balbriggan	1	—	—	—	—	—	—	—
Ballynass	—	—	1	—	—	—	—	—
Buncrana	—	—	1	—	—	—	—	—
Bruckless	—	—	1	—	—	—	—	—
Carnlough	1	—	—	—	—	—	—	—
Courtown	—	—	—	—	—	—	1	—
Clonakilty	1	—	—	—	—	—	—	—
Carrickfergus*	1	—	—	—	—	—	—	—
Coleraine	1	—	—	—	—	—	—	—
Cork*	1	—	—	—	—	—	—	—
Clare Castle	1	—	—	—	—	—	—	—
Donaghadee	1	—	—	—	—	—	—	—
Drogheda*	1	—	—	—	—	—	—	—
Dunmore	1	—	—	—	—	—	—	—
Dundalk*	1	—	—	—	—	—	—	—
Dublin*	1	—	—	—	—	—	—	—
Dundrum	—	—	—	—	1	—	—	—
Foynes	1	—	—	—	—	—	—	—
Greenore*	—	—	—	—	1	—	—	—
Greencastle	—	—	1	—	—	—	—	—
Galway*	—	—	1†	—	—	—	—	—
Howth	1	—	—	—	—	—	—	—
Inniscoo	—	—	—	—	—	—	1	—
Jeelin	—	—	—	—	—	—	1	—
Killough	—	—	—	—	1	—	—	—
Kilkeel	1	—	—	—	—	—	—	—
Kingstown	1	—	—	—	—	—	—	—
Kircubbin	—	—	—	—	1	—	—	—
Killybegs	—	—	1	—	—	—	—	—
Kilteery	1	—	—	—	—	—	—	—
Kildysart Pier and Harbour	1	—	—	—	—	—	—	—
Kilrush Pier and Harbour	1	—	—	—	—	—	—	—
Larne*	1	—	—	—	—	—	—	—
Limerick*	1	—	—	—	—	—	—	—
Londonderry*	1	—	—	—	—	—	—	—
Leabgarrow	—	—	1	—	—	—	—	—
Mullaghmore	—	—	—	—	—	—	1	—
Moville	—	—	1	—	—	—	—	—
Mountcharles	—	—	1	—	—	—	—	—
Carried forward	26	—	9	—	6	—	6	—

* Non-prohibited Port, *i.e.*, Port into which explosives not requiring license under Explosives Act may be brought.
† 50 lbs.

Place.	Under Explosives Act.						Where either (*a*) no Trade in Explosives exists; or (*b*) where such Traffic has been prohibited by Powers other than the Explosives Act.	
	Byelaws made regulating General Trade.		Byelaws made limiting Traffic.		Byelaws made prohibiting Traffic.			
	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.	Previous to 1894.	During 1894.
IRELAND—*cont.*								
Brought forward	26	—	9	—	6	—	6	—
Newcastle (County Down)	1	—	—	—	—	—	—	—
Newry*	1	—	—	—	—	—	—	—
Portaferry	1	—	—	—	—	—	—	—
Port Rush	—	—	—	—	—	—	1	—
Portsalon	—	—	1	—	—	—	—	—
Portnablahey	—	—	1	—	—	—	—	—
Quoile	—	—	—	—	1	—	—	—
Querrin	1	—	—	—	—	—	—	—
Red Bay	1	—	—	—	—	—	—	—
Rogerstown	—	—	—	—	—	—	1	—
Rosslare	—	—	—	—	—	—	1	—
Rush	—	—	—	—	—	—	1	—
Rathmullan	—	—	1	—	—	—	—	—
Sligo*	1	—	—	—	—	—	—	—
Strangford	—	—	—	—	—	—	1	—
Saleen Pier and Harbour	1	—	—	—	—	—	—	—
Teelin	—	—	1	—	—	—	—	—
Waterford*	1	—	—	—	—	—	—	—
Westport* (Quay)	1	—	—	—	—	—	—	—
Wexford*	1	—	—	—	—	—	—	—
Total	36	—	13	—	7	—	11	—

* Non-prohibited Port, *i.e.*, Port into which explosives not requiring license under Explosives Act may be brought.

SUMMARY.

Country.	Byelaws Approved.										No. of Harbours and Docks the Authorities of which have either prohibited the Traffic of Explosives altogether under powers which they possess independently of the Explosives Act, 1875, or have represented that there is not and is not likely to be any Traffic in Explosives at their Harbours or Docks.			Total No. of Harbours and Docks provided for.
	Regulating Traffic in Explosives.			Limiting Traffic to 30 lbs.			Prohibiting Traffic under Explosives Act, 1875.			Total.				
	Previous to 1894.	During 1894.	Total.	Previous to 1894.	During 1894.	Total.	Previous to 1894.	During 1894.	Total.		Previous to 1894.	During 1894.	Total.	
ENGLAND AND WALES	80	1	81	5	—	5	21	—	21	107	15	—	15	122
SCOTLAND	20	1	21	5	—	5	42	—	42	68	21	—	21	89
IRELAND	36	—	36	13	—	13	7	—	7	56	11	—	11	67
TOTALS	136	2	138	23	—	23	70	—	70	231	47	—	47	278

APPENDIX J.

Abstract showing Total Amount of Explosive Imported.

Amorces.	Ballistite.	Bellite.	B. N. Powder.	Britainite.	Capped Cartridge Cases for Q. F. A.	Carbonite.	Chilworth Special Powder.	C. L. Powder.
Lbs. 25 (H. J. Cadwell).	Lbs. 9,300 (Chilworth Gunpowder Co., Limited).	Lbs. 30,000 (Lancashire Explosives Co., Limited).	Lbs. 429 (Maxim Nordenfelt Guns and Ammunition Co., Limited).	Lb. 1 sample (P. B. Crowe).	1,605 (Hotchkiss Ordnance Co., Limited).	Lbs. 202,000 ½ lb. sample } (A. F. Richter).	Lbs. 120 (Chilworth Gunpowder Co., Limited).	Lbs. 400 (J. R. Watson).
25 lbs.	9,300 lbs.	30,000 lbs.	429 lbs.	1 lb sample.	1,605.	202,000 lbs.; ½ lb. sample.	120 lbs.	400 lbs.

Cooppal's Powder.	Detonators.	Dynamite No. 1.	Fulminate of Mercury.	Fuzes for Shells.	Gelatine Dynamite. (including Gelignite).	Guncotton.	Manufactured Fireworks.
Lbs. 5,400 ½ lb. sample } (J. R. Watson).	4,990,000 (C. G. Mueller). 1,350,000 (J. Darlington). 699,800 (British and Colonial Explosives Co., Limited). 616,000 (A. F. Richter). 1,480,000 (J. R. Watson). 10,000 (Benley & Co.). 618,000 (Beutner & Co.). 1,600 (Hotchkiss Ordnance Co., Limited).	Lbs. 11,000 (J. Darlington). 12,000 (C. G. Mueller).	Lbs. 7,200 (A. Helcké).	1825 (Hotchkiss Ordnance Co.).	Lbs. 147,000 (J. Darlington). 120,500 (Alliance Explosives Co., Limited). 12,000 (A. F. Richter).	Lbs. 5,000 (J. Clark & Co.).	Lbs. 2,000 (J. D. Hewett & Co.). 700 (J. Pain & Sons).
5,400 lbs. ½ lb. samples.	9,765,400.	23,000 lbs.	7,200 lbs.	1825.	279,500 lbs.	5,000 lbs.	2,700 lbs.

Matagnite Gelatine.	Oriental Fireworks.	Progressite.	Tonite.	Tubes for Firing Explosives.	Von Forster's Powder.	Walsrode Powder.	Westfalite.
Lbs. 35,302 (J. R. Watson).	Lbs. 60 (Sanders, Rehdars, & Co.) 220,080 (C. T. Brock & Co.). 3 (American Trading Co.). 185,000 (M. Samuel & Co.). 23,000 (J. Moss & Co.). 100,000 (J. Pain & Sons). 50,000 (J. D. Hewett & Co.).	Lbs. ¼ lb. sample. (A. F. Richter).	Lbs. 100 (Nobel's Explosives Co., Limited).	Lb. 1 (Sir J. Whitworth & Co.).	Lbs. 100 (Ballincollig Royal Gunpowder Mills Co., Limited).	Lbs. 9,382 (Beutner & Co.).	Lbs. 1,780 (D. Paisley). 2,000 (Benley & Co.).
35,302 lbs.	578,143 lbs.	¼ lb. sample.	100 lbs.	1 lb.	100 lbs.	9,382 lbs.	3,780 lbs.

APPENDIX K.

IMPORTATION LICENSES for EXPLOSIVES granted during 1894.

Class and Name of Explosive.			No. of Importation Licenses granted during the year.
Class 2.	Westfalite*		3
Class 3.	Division 1.	Ballistite*	3
		Blasting Gelatine, Nos. 1 and 2.*	4
		Carbonite*	3
		Dynamite, No. 1*	6
		Gelatine Dynamite, Nos. 1 and 2.*	10
		Matagnite Gelatine*	6
Class 3.	Division 2.	Bellite*	4
		B.N. Powder	1
		Chilworth Smokeless Powder	2
		C. L. Powder	1
		Cooppal's Powder	3
		Guncotton	3
		Tonite	1
		Von Forster's Powder	1
		Walsrode Powder	1
Class 5.	Division 1.	Fulminate of Mercury	6
Class 6.	Division 2.	Fuzes for Shell	6
		Tubes for firing Explosive	2
	Division 3.	Capped Cartridge Cases for for Q.F.A.	4
		Detonators	33
		Electric Detonator Fuzes	1
		Tubes for firing explosive	2
Class 7.	Division 2.	Amorces	1
		Manufactured Fireworks	3
		Oriental Fireworks	13
Miscellaneous—			
		Britainite	1
		Carbonite (New Definition)	1
		Dyed Cooppal's Powder	1
		Progressite	1

* Including cartridges of Class 6, Division 2, made with the explosive.

APPENDIX L.

PORTS in GREAT BRITAIN for which IMPORTATION LICENSES are authorised to be granted.

Port.	County.	Harbour Authority.	Byelaws approved. Date.	Whether a Port approved by Customs.
Aberdovey	Merioneth	A. J. S. Corbet, Esq.	4/12/77	Approved, 8 July 1881 99,536 / 9
Bristol	Gloucester	The Corporation	1/7/76	Do.
Barrow	Lancashire	The Furness Railway Co.	24/9/78	Do.
Burntisland	Fife	The Corporation	11/10/78	Do.
Clyde (River)	Lanark	The Trustees of the Clyde Navigation	25/6/78	Do.
Clyde (Lower Estuary)	Lanark	The Board of Trade	14/2/77	Do.
Clyde (Upper Estuary)	*See* Clyde.			
Conway (Harbour)	Carnarvon	The Corporation	31/8/77	Do.
Falmouth	Cornwall	The Falmouth Harbour Commissioners	4/12/76	Do.
Glasgow	Lanark	The Clyde Navigation Trustees	25/6/78	Do.
Goole	York	The Trustees of the Aire and Calder Navigation, Goole.	7/11/76	3/12/84 99,536 / 34
Greenock	Renfrew	*See* Lower Clyde.		
Grangemouth	Stirling	Forth and Clyde Navigation	12/5/77	8 July 1881 99,536 / 9
Hull	York	The Corporation of Hull	21/3/77	Do.
Humber	York	The Humber Conservancy	14/4/77	Do.
Irvine	Ayr	The Irvine Harbour Trustees	14/4/77	Do.
King's Lynn	Norfolk	The Corporation	27/10/76	Do.
London	Middlesex	The Conservators of the River Thames	27/7/94*	Do.
Liverpool	Lancashire	The Mersey Docks and Harbour Board	12/7/77	Do.
Leith	Edinburgh	The Commissioners for the Harbour and Docks of Leith.	22/9/76 12/2/77	Do.
Mersey	Lancashire	The Mersey Docks and Harbour Board	12/2/77	Do.
Penarth	Glamorgan	The Lessees, Taff Vale Railway Co., Cardiff.	6/11/82	19 March 1883 4,714
Newport	Monmouth	The Newport Harbour Commissioners	6/11/82	Do.
Portsmouth	Hants	The Lords Commissioners of the Admiralty.	7/6/78	8 July 1881 99,536 / 9
Pembrey	Carmarthen	The Corporation	6/4/83	52819H / 5
Penzance	Cornwall	The Mayor, Aldermen, and Burgeses	20/2/79	14/11/81 54118v / 6
Penryn	Cornwall	The Corporation	9/10/79	23/11/81 54118v / 8
Plymouth	Devon	The Lords Commissioners of the Admiralty.	1/11/79	23/11/81 54118v / 10
Portmadoc	Carnarvon	Edward Breeze, Esq.	30/4/77	8 July 1881 99,536 / 9
Southampton	Hants	The Southampton Pier and Harbour Board.	27/7/76	Do.
Thames		The Conservators of the River Thames	27/9/94*	Do.
Tyne	Northumberland	The Tyne Improvement Commissioners	9/8/77	Do.
Whitehaven	Cumberland	The Trustees of the Town, Port and Harbour of Whitehaven.	28/8/79	Do.

* Amended bye-laws.

APPENDIX L (*a*).

NON-PROHIBITED PORTS in IRELAND, under the PEACE PRESERVATION ACT, 1881, &c. *i.e.*, PORTS into which EXPLOSIVES not requiring a LICENSE under the EXPLOSIVES ACT, 1875, may be brought.

Port.	County.	Harbour Authority.	Byelaws Approved. Date.	Whether a Port approved by Customs.	Act under which authorised.
Belfast	Antrim	The Harbour Commissioners, Belfast	14/12/76	—	Peace Preservation Act, Order in Council, 24th Feb. 1893, "The Peace Preservation (Ireland) Continuance Act, 1886," "The Criminal Law and Procedure (Ireland) Act, 1887," and "The Expiring Laws Continuance Act, 1892."
Carrickfergus	Antrim	The Carrickfergus Harbour Commissioners.	3/5/77	—	
Cork	Cork	The Cork Harbour Commissioners	14/7/77	—	
Drogheda	Louth	The Harbour Commissioners, Drogheda	8/5/77	—	
Dundalk	Louth	The Harbour Commissioners, Dundalk	1/11/78	—	
Dublin	Dublin	The Dublin Port and Docks Board	18/1/77	—	
Galway	Galway	The Harbour Commissioners, Galway	10/12/77	—	
Glenarm	Antrim	The Earl of Antrim, Glenarm Castle, Co. Antrim.	Nil.	—	
Greenore	Louth	The Dundalk and Greenore Railway Co., Greenore.	25/3/76*	—	
Larne	Antrim	James Chaine, Esq., Ballycraigey, co. Leitrim.	—	—	
Limerick	Limerick	The Harbour Commissioners, Limerick	5/8/78	—	
Londonderry	Londonderry	The Harbour Commissioners, Londonderry.	6/11/78	—	
Newry	Down	The Newry Navigation Co.	8/9/76	—	
Sligo	Sligo	The Harbour Commissioners, Sligo	23/10/76	—	
Waterford	Waterford	The Harbour Commissioners, Waterford	8/9/82	—	
Westport (Quay)	Mayo	The Westport Harbour Commissioners	5/5/93	—	
Wexford	Wexford	The Harbour Commissioners, Wexford	10/1/77	—	

* Greenore Harbour. PROHIBITORY Byelaws made.

APPENDIX L (*b*).

IMPORTATIONS of GUNPOWDER from the under-mentioned COUNTRIES, and the Total Import into the UNITED KINGDOM in each Year from 1870 to 1894 both inclusive.

Year.	Germany.		Holland.		Belgium.		Other Countries.		Total Import.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Cwt.	£	Cwt.	£	Cwt.	£	Cwt.	£	Cwt.	£
1894	898	6,597	—	—	967	2,467	—	—	1,865	9,064
1893	754	9,934	140	784	942	2,872	2	33	1,838	13,623
1892	884	8,688	314	514	2,580	8,968	38	370	3,816	18,540
1891	4,004	9,186	—	—	1,842	6,381	—	—	5,846	15,567
1890	8,562	16,456	3,782	16,920	1,316	4,554	73	347	13,733	38,277
1889	2,032	4,142	8,720	42,783	1,288	4,601	43	295	12,083	51,821
1888	1,475	9,514	4,417	24,404	676	1,982	477	1,733	7,045	37,633
1887	—	—	3,437	21,998	1,119	8,788	2,725	15,872	7,281	46,658
1886	9,735	70,095	10,965	63,013	662	4,046	620	3,090	21,982	140,244
1885	12,304	75,976	25,185	171,995	1,342	2,523	150	480	38,981	250,974
1884	1,361	3,260	4,973	26,490	448	1,133	—	—	6,782	30,883
1883	6,518	32,308	4,671	27,495	—	—	286	1,510	11,475	61,313
1882	7,719	29,968	1,403	7,162	—	—	—	—	9,122	37,130
1881	4,622	12,188	5,815	32,472	—	—	—	—	10,437	44,660
1880	2,899	13,161	1,933	8,660	—	—	—	—	4,832	21,821
1879	3,738	8,312	1,632	3,102	1,860	8,980	350	779	7,580	21,173
1878	1,125	2,500	210	1,490	—	—	—	—	1,335	3,990
1877	3,555	7,900	1,000	1,500	—	—	—	—	4,555	9,400
1876	—	—	—	—	—	—	60	672	60	672
1875	1,076	2,132	760	3,750	60	500	—	—	1,896	6,382
1874	—	—	—	—	892	4,000	—	—	892	4,000
1873	6	66	—	—	5,810	27,866	—	—	5,816	27,932
1872	—	—	—	—	5,730	17,140	—	—	5,730	17,140
1871	—	—	—	—	—	—	—	—	—	—
1870	—	—	—	—	1,175	6,580	12	68	1,187	6,648

NOTE.—The quantity imported from Holland may be taken to represent gunpowder of German production.

APPENDIX L (*c*).

QUANTITY and VALUE of GUNPOWDER of British Produce exported from the UNITED KINGDOM in each of the years 1870 to 1894 inclusive.

Years.	Quantity.	Value.	Average value per cwt.
	Cwt.	£	£ s. d.
1894	73,642	198,366	2 13 10
1893	68,440	194,277	2 16 9
1892	70,855	203,327	2 17 5
1891	100,218	274,394	2 14 9
1890	92,236	252,828	2 14 10
1889	95,354	273,700	2 17 5
1888	120,746	363,270	3 0 2
1887	87,397	263,394	3 0 3
1886	103,555	288,725	2 15 9
1885	113,963	318,146	2 15 10
1884	142,721	387,392	2 14 3
1883	141,361	384,639	2 14 5
1882	126,634	356,320	2 16 3
1881	128,241	369,607	2 17 8
1880	133,281	372,585	2 15 11
1879	108,926	311,612	2 17 2
1878	126,994	349,178	2 14 11
1877	144,241	394,577	2 14 8
1876	127,399	359,722	2 16 5
1875	134,336	395,638	2 18 10
1874	133,312	415,716	3 2 4
1873	148,452	442,170	2 19 6
1872	177,586	485,434	2 14 1
1871	164,437	440,454	2 13 9
1870	154,979	427,229	2 15 9

APPENDIX L (*d*).

QUANTITY and VALUE of GUNPOWDER of Foreign and Colonial Produce Exported from the UNITED KINGDOM in each of the years from 1870 to 1894 inclusive.

Years.	Quantity.	Value.
	Cwts.	£
1894	1,182	8,290
1893	326	1,591
1892	1,663	5,192
1891	1,250	4,575
1890	4,542	14,821
1889	2,915	17,568
1888	1,805	5,504
1887	1,266	7,603
1886	6,810	43,945
1885	3,689	16,298
1884	184	710
1883	1,527	8,433
1882	268	1,028
1881	2,713	11,373
1880	1,475	8,480
1879	867	3,177
1878	289	1,733
1877	1,100	3,696
1876	72	150
1875	780	3,851
1874	—	—
1873	—	—
1872	—	—
1871	—	—
1870	2,650	14,840

Commercial Department, Board of Trade,
9th January 1895.

APPENDIX M.

Counties visited for the purpose of Inspection, &c. during the year.

ENGLAND AND WALES.

Anglesey.
Berkshire.
Bucks.
Cardigan.
Carmarthen.
Carnarvon.
Cheshire.
Cornwall.
Cumberland.
Denbigh.
Derby.
Devon.
Dorset.
Durham.
Essex.
Flint.
Glamorgan.
Gloucester.
Hertford.
Kent.
Lancashire.
Leicester.
Merioneth.
Middlesex.
Monmouth.
Montgomery.
Northumberland.
Nottingham.
Oxford.
Pembroke.
Radnor.
Salop.
Somerset.
Southampton.
Stafford.
Suffolk.
Surrey.
Sussex.
Warwick.
Westmoreland.
Worcester.
Yorkshire.

Total, 42.

SCOTLAND.

Aberdeen.
Argyll.
Ayr.
Banff.
Clackmannan.
Edinburgh.
Fife.
Forfar.
Haddington.
Inverness.
Lanark.
Linlithgow.
Orkney.
Perth.
Renfrew.
Ross.
Shetland.
Stirling.

Total, 18.

IRELAND.

Antrim.
Clare,
Cork.
Down.
Dublin.
Galway.
Kerry.
Limerick.
Londonderry.
Mayo.

Total, 10.

Grand Total, 70.

APPENDIX N.

Borough and Urban Sanitary Local Authorities Visited since the Act came into operation.

ENGLAND AND WALES.

Aberystwith.*
Abingdon.*
Ambleside.*
Andover.*
Appleby.
Arundel.*
Banbury.*
Barnstaple.
Barrow.
Basingstoke.*
Bath.
Battle.*
Beaumaris.*
Bedford.
Bedminster.
(Somerset, part of Bristol).
Belper.
Bethesda.*
Beverley.
Bideford.*
Birmingham.
Blackburn.
Bodmin.
Bolton.
Bootle.
Boston.
Bradford.
Brecon.*
Bridgnorth.*
Bridgewater.
Brighton.
Bristol.
Buckingham.*
Burnley.
Bury.
Buxton.
Cambridge.
Canterbury.
Cardiff.
Cardigan.*
Carlisle.
Carmarthen.
Carnarvon.
Chester.
Chesterfield.
Chichester.*
Cockermouth.
Colchester.
Coventry.
Croydon.
Dartmouth.*
Deal.*
Denbigh.*
Derby.
Devonport.
Dewsbury.
Doncaster.
Dorchester.*
Dover.
Droitwich.*
Dudley.
Durham.
Eastbourne.*
Ely.
Exeter.
Falmouth.*
Faversham.*
Festiniog.*
Flint.*
Folkestone.*
Frome.
Gateshead.
Glastonbury.*
Gloucester.
Gosport.
Grantham.
Gravesend.
Great Grimsby.
Great Torrington.
Great Yarmouth.
Guildford.
Halifax.
Hanley.
Hartlepool.
Harwich.*
Hastings.
Haverfordwest.*
Helston.*
Herne Bay.*
Hereford.
Hertford.
High Wycombe.
Honiton.
Hove.
Huddersfield.
Hull.
Hythe.*
Ilfracombe.*
Ipswich.
Kendal.
Kidderminster.
Kingston-on-Thames.
Leamington.
Leeds.
Leicester.
Lewes.*
Lichfield.*
Lincoln.
Liskeard.
Liverpool.
Llandilo.
Llandovery.*
London City.
Lynn.
Maidenhead.*
Maidstone.
Malmesbury.*
Manchester.
Margate.
Middlesboro'.
Mold.*
Monmouth.
Morley.
Much Wenlock.
Neath.
Newark.
Newbury.
Newcastle-upon-Tyne.
Newport*
(I. of W.).
Newport (Mon.)
Northampton.
Norwich.
Nottingham.
Oldham.
Oswestry.*
Oxford.
Penrhyn.*
Penzance.
Peterboro'.
Plymouth.
Pontefract.*
Pontypridd.
Poole.
Portmadoc.
Portsmouth.
Preston.
Ramsgate.
Reading.
Reeth.*
Reigate.
Richmond, Yorks.*
Ripon.*
Rochdale.
Rochester.
Romsey.*
Rotherham.
Runcorn.
Ruthin.*
Ryde.
Rye.*
Salford.
Salisbury.
Sandwich.*
Scarborough.
Sheffield.
Shrewsbury.
Southampton.
South Molton.*
Southport.
South Shields.
Stafford.
Stratford.*
St. Albans.
St. Helen's.
St. Ives, Cornwall.*
Sunderland.
Swansea.
Tenby.*
Tewkesbury.*
Thetford.*
Tiverton.
Totnes.*
Truro.
Tunbridge Wells.
Tynemouth.
Ulverston.
Wakefield.
Wallingford.*
Walsall.
Wareham.
Warwick.
Wells, Norfolk.
Wells, Somerset.*
Weymouth.
Whitehaven.*
Wigan.
Windsor.
Winchester.
Wisbech.*
Wolverhampton.
Worcester
Worksop.
Wrexham.
Yarmouth.
Yeovil.
York.

Total, 205.

* Not Local Authorities under Explosives Act, 1875.

SCOTLAND.			IRELAND.	
Aberdeen.	Forfar.	Lerwick.	Athlone.	England and Wales 205
Airdrie.	Forres.	Linlithgow.	Belfast.	Scotland - - 66
Alloa.	Fortrose.	Montrose.	Bray.	Ireland - - 20
Arbroath.	Galashiels.	Musselburgh.	Carrickfergus.	
Ayr.	Glasgow.	Nairn.	Coleraine.	Grand Total - 291
Banff.	Govan.	Oban.	Cork.	
Berwick.	Greenock.	Paisley.	Dalkley.	
Burntisland.	Haddington.	Peebles.	Drogheda.	
Campbeltown.	Hamilton.	Perth.	Dublin.	
Cullen.	Hawick.	Peterhead.	Enniskillen.	
Cupar.	Inveraray.	Port Glasgow.	Galway.	
Dingwall.	Inverness.	Portobello.	Kilkenny.	
Dornoch.	Irvine.	Queensferry, North.	Limerick.	
Dumbarton.	Jedburgh.	Queensferry, South.	Londonderry.	
Dumfries.	Keith.	Renfrew.	Newry.	
Dunbar.	Kilmarnock.	Rothesay.	Queenstown.	
Dundee.	Kintore.	Rutherglen.	Sligo.	
Dunfermline.	Kirkcaldy.	Selkirk.	Tralee.	
Dunse.	Kirkcudbright.	St. Andrews.	Waterford.	
Edinburgh.	Kirkwall.	Stirling.	Wexford.	
Elgin.	Lanark.	Tain.		
Fife.	Leith.	Wick.	Total, 20.	
		Total, 66.		

This is exclusive of several boroughs, the Town Councils of which are not the Local Authority under the Explosives Act, to which visits have been paid.

APPENDIX O.

Home Office, Whitehall, S.W.,
7th February 1894.

GENTLEMEN,

I should be very much obliged to you if you would inform me whether in your experience of compressing gunpowder into pellets or prisms, whether for cartridges for mining, blasting, or small-arms, you have had occasion to use any of the machines which are commonly known as "cam" machines; and whether your experience has been favourable or unfavourable to the use of these machines; and, more particularly, whether you have seen any reason to believe that the use of such machines is attended with special risk; and, if so, of what character.

I have, &c.
(Signed) V. D. MAJENDIE, Colonel,
H.M.'s Chief Inspector of Explosives.

To Gunpowder Manufacturers.

REPLIES from GUNPOWDER MAKERS in the UNITED KINGDOM, relative to CAM PRESSES, including a REPORT on the use of these MACHINES in GERMANY, by Mr. HEIDEMANN.

Home Office Index No. of Factory.	Substance of Reply.
40	Have never seen a cam machine.
143	Have no experience of cam machines.
33	Have never used cam machines, but after an accident in 1883 had cam and hydraulic presses under consideration, and decided in favour of the latter.
11	Have four machines, of which two are identical with the Waltham Abbey ones. They have been in constant use since 1886, and their experience of them is entirely favourable; "of course, it is essential that the machines are kept in proper condition."
37	Were the first to introduce the principle of the cam machines about 20 years ago, and have used that process continuously since, for compressed cartridges for blasting purposes, and for prismatic military powder. Their experience is in favour of this form of manipulation, and they know of no special risk connected with its use.
34	Have no experience of cam machines; they have used hydraulic machines for about 12 years without any accidents.
24	Have had no experience of cam machines; they use hydraulic machines in preference.
19	Have not had any experience of cam cartridge pressing machines; in their opinion the working of such a machine would be attended with danger.

Home Office Index No. of Factory.	Substance of Reply.
49	They forward the following extract from their manager's letter :—"In the year 1890 we erected "two cam machines, with the requisite driving gear, at a cost of between 2,000*l.* and 3,000*l.*, "for the moulding and pressing of S.B.C. and other brown prismatic powders. After "starting the machines, and before we had taken out about a dozen pressings, we had trouble "with the plungers and pins, the first bending and breaking, and the latter getting bent and "jamming. We thought perhaps we might get over the difficulty, but before we had made "20 cases of S.B.C. we had to abandon the use of these machines from their extremely "dangerous character, and lose our 2,500*l.*, as we have never worked them since this time. "In fact, from the continual jamming and breaking of the plungers and pins, our men "expressed so much anxiety over the danger in working these machines, that we consulted "our chief engineer, who agreed that the cam presses were dangerous, and the responsibility "resting upon us was too great to insist upon the men working them, as we were persuaded "from the experience we had had that an accident sooner or later must follow."
53	Their manager's experience with cam presses has been for pellets only, but they add that "he is well acquainted with those used for prismatic powder, and has no hesitation in "giving his opinion that from the quick action of these machines, and the number of "frictional parts, there is a great deal more risk attending their use than with machines "worked by hydraulic pressure. With the latter, one pressing is performed in about five or "six minutes, and the machine is completely under control. With the cam machines from "10 to 15 pressings can be turned out per minute, and as they work automatically they are "not under immediate control, but if they were made to work slowly the risk would be much "reduced, and would hardly exceed that with hydraulic machines."
1	The machine in use at their mills for making compressed blasting cartridges has a "cam" action. It has worked very satisfactorily for 10 years, there has been no accident, and they are not aware of any special danger or risk attending the use of it.
2	Their experience is very limited, as they have only used such a machine for pressing cartridges for mining purposes, and that only more for an experiment than otherwise. They gave up the machines, not as a matter of danger, but unsatisfactory working. They are now erecting a large hydraulic machine to do the work.

Report by Mr. Heidemann on the Use of Cam Presses in Germany.

(Translation.)

Cologne, March 19, 1894.

Replying to the questions put by Sir Frederick Abel, and transmitted to me by Messrs. E. Kraftmeier & Co., respecting my experience with cam presses, I beg to state as follows :—

1. Sixteen Excenter (cam) presses have been in use since the year 1865 in our factories under my personal notice.
2. Besides several accidents to workmen, attended by a few contusions and bodily mutilations, which were the consequences of offences against the factory regulations, and of carelessness on the part of the workmen in attending to the machines, the following more serious accidents, causing loss of life, have occurred with these presses during the period mentioned above :—
   (*a.*) In 1878 an explosion took place at Hamm a/Sieg in an Excenter (cam) press during the manufacture of seven-hole black prismatic powder, by which two other presses were fired. The explosion was caused by a workman, notwithstanding the strictest prohibition, forcing a brass needle by hard blows into one of the channels of the upper bar while cleaning the same.
   (*b.*) Another explosion took place in 1881, also at Hamm a/Sieg, in an Excenter (cam) press during the manufacture of one-hole black prismatic powder. In this case the cause was the working of the press contrary to special instruction, after the breaking of a steel pin, without previously removing all the powder from the press.
   (*c.*) In 1885 the loose remnants of powder were fired in an Excenter (cam) press at Dueneberg without doing any damage; this was caused by the carelessness of the workmen in removing a broken pin.
3. The velocity with which our presses are worked varies from three to four pressings a miuute, the maximum in exceptional cases is four and one-half pressings.

Besides the above-mentioned Excenter (cam) presses we have also in use at our factories three hydraulic presses for prisms with accumulators, which, as a rule, have 12 stamps or dies, and work at a velocity of four and one-half pressings a minute. These presses allow of a larger production, and of the use of higher pressure than the cam machines. They require a specially trained and thoroughly reliable staff of workmen. For the working of these presses generally, the following special factory rules are in force :—

(*a.*) During the working of the presses the quantity of powder in the house must be reduced to the smallest possible limit.

(*b.*) While the presses are working, every movement must be carefully watched, and they must never work without supervision.

(*c.*) When the least irregularity is noticed, the press must be stopped immediately, all powder must be removed, and then only may the cause be looked for; should any repairs or alterations of the press become necessary, the press itself, as also the floor within a radius of 3 metres, must be thoroughly wetted with water; during such repairs a watering-pot full of water must be kept handy.

(*d.*) The channels in the upper stamps as well as in the upper bar must always be kept clear, and for this purpose they must frequently be examined by inserting a wooden spill, which also serves to clean them.

(*e.*) The presses must be erected carefully, and must fit tightly and well into all beds and moving parts; to ensure safe and smooth movements, all friction must be avoided.

(Signed) HEIDEMANN.

APPENDIX P.

A LIST of the more important OUTRAGES and ATTEMPTS, and suspicious cases of DISCOVERIES of EXPLOSIVES (exclusive of scares), which have engaged the attention of Her Majesty's Inspectors of Explosives during the Period 1881–1894, inclusive.

1881.

14 *January.*—An attempt to blow up the barracks at Salford by dynamite. The injury to the barracks was insignificant, but one boy was killed and another injured. (*See* Annual Report for 1881, page 46.) — Salford Barracks.

16 *March.*—An attempt to injure the Mansion House, London, by a box containing from 15 to 20 lbs. of gunpowder. The touchpaper by which the gunpowder was to have been fired was extinguished by a policeman. (*Ibid.*, page 47.) — Mansion House, London.

16 *May.*—An attempt to blow up the police barracks at Liverpool with gunpowder in iron piping. The damage to the building was inconsiderable, and no one was hurt. (*Ibid.*, page 48.) — Police Barracks, Liverpool.

10 *June.*—An attempt to blow up the Town Hall, Liverpool, by an infernal machine probably filled with dynamite. A great number of windows were broken, and some iron railings were destroyed, but no one was injured. The two perpetrators were captured. (*Ibid.*, page 47.) — Town Hall, Liverpool.

14 *June.*—A piece of iron piping filled with gunpowder exploded against the police station at Loanhead, near Edinburgh. Some windows were broken, but no other damage was effected. (*Ibid.*, page 50.) — Police Station, Loanhead (Edinburgh).

30 *June.*—An importation of six infernal machines at Liverpool from America in the "Malta," concealed in barrels of cement. They contained lignin dynamite, with a clockwork arrangement for firing it. (*Ibid.*, page 50.) — Importation of infernal machines at Liverpool.

2 *July.*—An importation of four similar machines at Liverpool in the "Bavaria." (*Ibid.*, page 50.)

15 *August.*—A large sandboat moored in the Tay at Perth, blown up with dynamite. The perpetrator was convicted and sentenced to 12 months' imprisonment. (*Ibid.*, page 47.) — Boat at Perth.

8 *September.*—An attempt to produce an explosion at the barracks, Castlebar. A canister containing gunpowder was thrown over the wall, close to the magazine. The lighted fuze which was attached fell out, and no harm was done. (*Ibid.*, page 47.) — The Barracks, Castlebar.

1882.

18 *February.*—Boxes fitted up as infernal machines sent to various persons in Edinburgh, by a man who was afterwards convicted of the offence and sentenced to 20 years' penal servitude. About eight persons were injured. (Annual Report for 1882, page 47.) — Edinburgh.

26 *March.*—An attempt to blow up Weston House, Galway, with dynamite in an iron pot enclosed in a sack. Five persons were afterwards convicted of the outrage. (*Ibid.*, page 49.) — Weston House, Galway.

1882—*cont.*

Letterkenny. Co. Donegal. — 27 *March.*—A 6-inch shell charged with explosive thrown into a house in Letterkenny. The explosion caused considerable damage. (Annual Report for 1882, page 47.)

Police Barracks, Limerick. — 2 *April.*—An attempt to destroy the police barracks in Limerick by firing some dynamite on the window sill. (*Ibid.*, page 47.)

Mansion House, London. — 12 *May.*—A discovery of a parcel containing 12 lbs. to 20 lbs. of gunpowder with lighted touch paper or fuze attached at the Mansion House, London. (*Ibid.*, page 47.)

1883.

Glasgow Gas Works. — *20 *January.*—An explosion of lignin dynamite at Tradeston Gasworks, Glasgow, doing considerable damage. (Annual Report for 1883, page 48; Special Report, No. L., dated 14th March 1883.)

Possil Bridge, Glasgow. — *21 *January.*—An explosion of lignin dynamite at Possil Bridge, Glasgow. Two or three persons passing sustained slight injury. (*Ibid.*, page 48.)

Buchanan Street Station, Glasgow. — *21 *January.*—An explosion of lignin dynamite at Buchanan Street Station, Glasgow, in a disused goods shed. (*Ibid.*, page 48.)

Local Government Board, Whitehall. — 15 *March.*—An explosion at the Local Government Board Office, Whitehall, causing considerable local damage. (Annual Report for 1883, page 48; Special Report, No. LI., dated 27th April 1883.)

Times Newspaper Office. — 15 *March.*—An abortive explosion of lignin dynamite outside a window at the "Times" office. (*Ibid.*)

Liverpool infernal machines. — 27 *March.*—Two infernal machines, containing 28 lbs. of lignin dynamite (probably home made), discovered at Liverpool. Four persons were convicted and sentenced to penal servitude for life. (Annual Report for 1883, page 49.)

Manufacture of nitro-glycerine at Birmingham. — 5 *April.*—The discovery of a factory of nitro-glycerine at Birmingham, and of a large amount of nitro-glycerine brought thence to London. The occupier of the house and others were subsequently convicted and sentenced to penal servitude for life. (Annual Report for 1883, p. 7.)

Underground Railway, Westminster. — 30 *October.*—An explosion in the Metropolitan Railway, between Charing Cross and Westminster, unattended with personal or serious structural injury. (*Ibid.*, page 49; Special Report, No. LV., dated 17th November 1883.)

Underground Railway, Praed Street. — 30 *October.*—An explosion on the Metropolitan Railway, near Praed Street. Three carriages sustained serious injury, and about 62 persons were cut by the broken glass and débris, and otherwise injured. (*Ibid.*, page 49.)

Westminster infernal machines. — 22 *November.*—Two infernal machines discovered in a house in Westminster, occupied by a German named Woolf. Two men were tried and in the result the jury disagreed and a *nolle prosequi* was entered on behalf of the Crown. (Annual Report for 1883, page 50.)

1884.

Primrose Hill Tunnel. — 16 *January.*—The discovery of some slabs of Atlas Powder A. (American make) in Primrose Hill tunnel.

London railway stations; outrages; Victoria. — 26 *February.*—An explosion in the cloak room of the London, Brighton, and South Coast Railway at Victoria Station of Atlas Powder A. (American make), left in a bag or portmanteau. (Annual Report for 1884, page 37; Special Report, No. LIX., dated 8th March 1884.)

Charing Cross. — 27 *February.*—The discovery of a bag containing some Atlas Powder A., with clockwork and detonators at Charing Cross Station. (*Ibid.*, page 37.)

Paddington. — 28 *February.*—A similar discovery at Paddington Station. (*Ibid.*, page 37.)

Ludgate Hill. — 1 *March.*—A similar discovery at Ludgate Hill Station. (*Ibid.*, page 37.)

Birkenhead. (Daly's bombs.) — 11 *April.*—A discovery of three metal bombs, containing dynamite (probably American make), at Birkenhead, in possession of a man named Daly, who was afterwards sentenced to penal servitude for life. (Annual Report for 1884, page 38.)

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* In connexion with these three explosions, 10 persons were subsequently convicted. (*See* Annual Report for 1883, p. 48.)

1884—*cont.*

30 *May.*—An explosion of dynamite at the Junior Carlton Club, St. James' Square. About 14 persons were injured. (Annual Report for 1884, page 38; Special Report, No. LXII., dated 10th June 1884.) — Junior Carlton Club.

30 *May.*—An explosion of dynamite at the residence of Sir Watkin Williams Wynn, St. James' Square. (*Ibid.*, page 38.) — Sir Watkin Wynn's residence, St. James' Square.

30 *May.*—An explosion of dynamite in a urinal under a room occupied by some of the detective staff in Scotland Yard. It brought down a portion of the building, besides severely injuring a policeman and some persons who were at an adjacent public house. (*Ibid.*, page 37.) — Scotland Yard.

30 *May.*—A discovery of Atlas Powder A., with fuze and detonators, in Trafalgar Square. (*Ibid.*, page 38.) — Trafalgar Square.

28 *November.*—An attempted destruction of a house at Edenburn, near Tralee, occupied by Mr. Hussey. The injury, which was doubtless accomplished with dynamite, was less serious than was intended, and no one sustained bodily harm. (Annual Report for 1884, page 38; Special Report, No. LXVIII., dated 5th December 1884.) — Mr. Hussey's House, Edenburn, near Tralee.

13 *December.*—An explosion of a large charge of dynamite or other nitro-compound under London Bridge, fortunately doing very little damage. (*Ibid.*, page 38.) — London Bridge.

1885.

2 *January.*—An explosion in the Gower Street tunnel of the Metropolitan Railway, caused by about 2 lbs. of some nitro-compound fired apparently by a percussion fuze. Damage inconsiderable. (Annual Report for 1885, page 58.) — Explosion in Underground Railway (Gower Street)

24 *January.*—An explosion in the Tower of London, caused, beyond all reasonable doubt, by about 5 to 8 lbs. of Atlas Powder A. (American make). Three or four persons were slightly injured and considerable damage was done to the Armoury. (Annual Report for 1885, page 59). — Explosion at Tower of London.

24 *January.*—An explosion of a similar amount of Atlas Powder A. (American make), in Westminster Hall. Three persons were injured severely, and others slightly, and very considerable damage was done to the Hall and surroundings. (*Ibid.*, page 59.) — Westminster Hal.

24 *January.*—An explosion in the House of Commons (probably caused by a similar amount of the same explosive). No persons were injured, but very considerable damage was done to the Houses of Parliament. (*Ibid.*, page 59.) — House of Commons.

In connexion with these three last-named outrages two men (Burton and Cunningham) were afterwards convicted and sentenced to penal servitude for life. (*Ibid.*, page 59.)

10 *February.*—A discovery of dynamite (of American make), in a house in Harrow Road, Paddington. (*Ibid.*, page 59). — Harrow Road.

9 *March.*—A discovery of Atlas Powder A. in the roof of a sawmill at Bootle. (*Ibid.*, page 60.) — Bootle.

23 *April.*—Explosion of an infernal machine containing gunpowder, at Admiralty, Whitehall. Mr. Swainson, in whose room the explosion occurred, sustained severe injuries, and the room and neighbouring apartments were much damaged. (*Ibid.*, page 59.) — Admiralty.

1886.

24 *March.*—Attempted injury with blasting gelatine to the house of Mr. Tyzack, manager of the South Medomsley Colliery, Durham. (Annual Report for 1886, page 41.) — South Medomsley Colliery, Durham.

23 *June.*—An attempted injury, by explosion of dynamite, of new reservoir in connection with some new waterworks at Callington. (*Ibid.*, page 41.) — Callington.

12 *July.*—Bottles filled with gunpowder thrown among the crowd at an Orange demonstration at Derry. (*Ibid.*, page 41.) — Londonderry.

1 *September.*—Two attempts to injure residents by means of an iron pipe charged with powder and fuzed. (*Ibid.*, page 41.) — Limerick.

1887.

Dudley. 27 *January.*—Injury to three shops at Dudley by malicious explosion of gunpowder. (Annual Report for 1887, page 45.)

Harlech. 1 *January.*—An explosion maliciously effected (by means probably of guncotton or dynamite) in the streets of Harlech. (*Ibid.*, page 46.)

Kildysart, co. Clare. 17 *February.*—Attempted dynamite outrage at Paradise House, near Kildysart, co. Clare (the residence of the Recorder of Galway). (*Ibid.*, page 44.)

Walton, near Preston. 20 *March.*—Injury to a man at Walton, near Preston, by an infernal machine. (*Ibid.*, page 45.)

Preston. 8 *March.*—Attempted injury by tonite to canal near Preston. (*Ibid.*, page 44.)

Newcastle, West. 21 *April.*—Malicious explosion of gunpowder at house at Newcastle, West, occupied by Mr. John Murphy. (*Ibid.*, page 45.)

Hebburn. 4, 21, and 24 *May.*—Three outrages with explosives at Hebburn, Durham. (*Ibid.*, page 45.)

Llanerchymedd. 27 *July.*—Attempt to injure the police station at Llanerchymedd by means of gunpowder. (*Ibid.*, page 45.)

Ennis. 16 *August.*—Attempt to injure railway bridge at Ennis with dynamite. (*Ibid.*, page 45.)

Cavan. 23 *October.*—Malicious explosion at the house of County Inspector Ridge, Royal Irish Constabulary, at Cavan. (*Ibid.*, page 44.)

Case of Callan and Harkins. 20 *November.*—Discovery of conspiracy between Callan and Harkins to commit an outrage or outrages by means of dynamite. (*Ibid.*, page 46.)

Listowel. 6 *December.*—Attempt to injure the residence of the High Sheriff of Kerry, at Listowel. (*Ibid.*, page 45.)

Macroom. 16 *December.*—Explosion of an infernal machine on the premises of a person at Macroom who had offended the Land League. (*Ibid.*, page 45.)

Birkenhead. 16 *April.*—Explosion of gunpowder on the premises of a Mr. William Maddocks, contractor, Birkenhead, probably intended to cause alarm rather than real damage. (*Ibid.*, page 45.)

Bodvain Rectory (Denbighshire). *August.*—An outrage was perpetrated at Bodvain Rectory, Denbighshire, by exploding some substance against a window. (*Ibid.*, page 46.)

1888.

Ireland. 18 and 23 *February*, 18 *September*, and 6 *December.*—Five minor outrages or suspicious circumstances suggesting intended attempts at explosive outrages in Ireland—at Ennis, Listowel, Letterkenny, Coleraine, and Skibbereen. (Annual Report for 1888, page 44.)

Trooper's Hill, St. George, Gloucestershire. 29 *April.*—A small charge of gunpowder exploded close to a new small-pox hospital, Trooper's Hill, St. George, Gloucestershire. (*Ibid.*, page 44.)

1889.

Tipperary. 7 *September.*—Explosion of an infernal machine in Mr. Smith-Barry's office, near Tipperary. (Annual Report for 1889, page 41.)

Near Woodford, co. Galway. 18 *November.*—Attempt, by means of an infernal machine, to blow up the police and bailiffs engaged in carrying out evictions on Lord Clanricarde's estate near Woodford, co. Galway. (*Ibid.*, page 40.)

Rochdale. 28 *November.*—Attempt to explode infernal machine at Rochdale School Board Office. (*Ibid.*, page 41.)

1890.

Macroom. 27 *January.*—Explosion of infernal machine in main street of Macroom. (Annual Report for 1890, page 41.)

Toome, co. Antrim. 22 *March.*—Destruction of a hut at a railway crossing near Toome station, co. Antrim, by malicious explosion. (*Ibid.*, page 41.)

1890—*cont.*

17 *July.*—Attempt to do injury or to create alarm by means of an infernal machine at the Falmouth Custom House. (*Ibid.*, page 41.) — Falmouth.

25 *September.*—Explosion of a stone jar filled with gunpowder on window sill of a surgery occupied by Chairman of Town Commissioners, Tipperary. (*Ibid.*, page 42.) — Tipperary.

9 *October.*—Attempted outrage, by means of blasting powder, on the premises of a baker at Templecombe. (*Ibid.*, page 42.) — Templecomb

1891.

15 *January.*—Malicious injury, by explosion, to the Dawsholm Gasworks, near Glasgow. (Annual Report for 1891, page 40.) — Glasgow.

3 *July.*—Personal outrage, by the explosion of a detonator, to a woman in the streets of Sunderland. (*Ibid.*, page 40.) — Sunderland.

25 *October.*—Injury to offices of "National Press," in Dublin, by means of an explosive thrown into the building. (*Ibid.*, page 40.) — Dublin.

5 *November.*—Malicious explosion of tonite in the house of a police constable, and other houses at Croscombe, Somerset. (*Ibid.*, page 40.) — Croscombe.

31 *December.*—Malicious explosion in the offices of the Chief Secretary, Dublin Castle. (*Ibid.*, page 39.) — Dublin Castl

December.—Discovery of a packet of dynamite, with fuze, in the Dublin Post Office. (*Ibid.*, page 40.) — Dublin Post Office.

1892.

29 *January.*—Explosion of infernal machine at private residence near Bristol. (Annual Report for 1892, page 53.) — Bristol.

24 *March.*—Conviction of anarchists at Walsall for being in possession of explosives for unlawful purposes, under Explosive Substances Act, 1883. (*Ibid.*, page 53.) — Walsall anarchists.

5 *April.*—Explosion of infernal machine during Durham mining strike at house at Castle Eden Colliery. (*Ibid.*, page 53.) — Castle Eden Colliery.

5 *June.*—Explosion of dynamite or gelatine cartridge in doorway of house at Inverkeithing. (*Ibid.*, page 54.) — Inverkeithin

5 *August.*—Explosion of a quantity of gunpowder on window-sill of an hotel at Rathkeale. (*Ibid.*, page 54.) — Rathkeale.

12 *August.*—Explosion of a quantity of gunpowder in a miner's house at Low Spennymoor. (*Ibid.*, page 54.) — Spennymoor

24 *December.*—Explosion of infernal machine outside the Detective Office in Exchange Court, Dublin. One detective officer was killed. (*Ibid.*, page 53.) — Dublin Cast

1893.

19 *April.*—Discovery of a tin can containing about 10½ lbs. of gunpowder, with an arrangement for exploding it, on the line at the Newport end of the Gair tunnel. (Annual Report for 1893. Page 62.) — Monmouth.

6 *May.*—Explosion of an infernal machine at the Four Courts, Dublin, situated on the north bank of the Liffey, at Inns Quay. (*Ibid.*, page 62.) — Four Courts Dublin.

22 *July.*—Death of a man at Broadstairs, from the explosion of an infernal machine which had been sent to him by post. (*Ibid.*, page 62.) — Broadstairs, Kent.

28 *July.*—Explosion of a detonator in a public-house at Great Bridge, causing serious injury to three men. (*Ibid.*, p. 63.) — Great Bridg Staffordshire

27 *August.*—A cartridge, probably of tonite, was thrown into the garden of a farmhouse at Euxton causing damage to windows. (*Ibid.*, page 63.) — Chorley, Lancashire.

1893—*cont.*

Parr, near St. Helen's. — 17 *September.*—The house of a colliery fireman at Parr was wrecked by the explosion of some explosive, probably roburite. (Annual Report for 1893, p. 63.)

St. George's Cathedral, London. — 1 *October.*—Explosion, without injury, of some unknown substance during the service at St. George's (Roman Catholic) Cathedral, London. (*Ibid.*, page 63.)

Broad Oak Road, Parr. — 20 *October.*—Explosion of roburite on window-sill of a house occupied by a colliery fireman at Broad Oak Road, Parr. (*Ibid.*, page 63.)

Ovingham, Northumberland. — 27 *October.*—Explosion of some substance placed on the window-sill of a house occupied by a gamekeeper, at Ovingham. (*Ibid.*, page 63.)

Aldborough Barracks, Dublin. — 26 *November.*—Discovery of a tin box containing dynamite, with fuze attached, at Aldborough Barracks, Dublin. (*Ibid.*, page 64.)

Dalziel, Lanarkshire. — 10 *December.*—An explosion of a malicious character outside the dwelling-house of a gasman, in Cowies Square, Craigneuk, Dalziel. (*Ibid.*, page 64.)

1894.

Greenwich Park. — 15 *February.*—Explosion of a bomb near Greenwich Observatory, killing the man who was carrying it. (Annual Report for 1894, page 64.)

Bunwell, Norfolk. — — *April.*—Discovery of two tubes filled with gunpowder near the stained glass window of the village church of Bunwell. One man was arrested, tried, and acquitted. (*Ibid*, p. 65.)

Great Yarmouth. — 3 *April.*—A bomb containing gunpowder, nails, and scrap iron, with burning fuze attached, was found on a window-sill of the Conservative Working Men's Club at Great Yarmouth. (*Ibid.*, page 65.)

Farnara and Polti. — 14 *April.*—Discovery of a metal bomb, in connection with which two men named Farnara and Polti were afterwards sentenced, the former to 20 and the latter to 10 years' penal servitude. (*Ibid.*, page 65.)

Bryncethin, near Bridgend. — 20 *June.*—Explosion of dynamite, placed in the cellar of the Dunraven Hotel, Bryncethin, by a drunken miner, who was arrested and sentenced to seven years' penal servitude. (*Ibid*, p. 66.)

Steam launch "Kate." — 2 *August.*—Two tins containing gunpowder were exploded in a recess of the flues of the smoke-board of the "Kate," off Lerwick, doing slight damage. (*Ibid.*, page 66.)

Post Office, 177, New Cross Road, S.E. — 14 *August.*—Explosion of a packet placed in the letter-box of the Post Office at 177, New Cross Road, London, S.E. (*Ibid.*, page 66.)

General Post Office, London. — 27 *August.*—Discovery of a large Chinese cracker amongst collection of letters. General Post Office. (*Ibid.*, page 66.)

Galway. — 2 *October.*—Explosion of a tin of gunpowder in a house on the Clanricarde Estate, Galway. (*Ibid.*, page 66.)

Walsall. — 11 *October.*—Discovery of a gas tube containing gunpowder, with lighted fuze attached, on the window-sill of the Metropolitan Bank, Walsall. (*Ibid.*, page 66.)

Tilney Street, Mayfair. — 4 *November.*—Bomb outrage in Tilney Street, Mayfair, at the house of the Hon. R. Brett. No one was injured. (*Ibid.*, p. 67.)

East Rainton, Durham. — 15 *November.*—Two pieces of metal piping about 2″ bore, and from 8″ to 12″ in length, filled with gunpowder, were placed on door-step and window-sill, and fired simultaneously, doing considerable damage. The author of the outrage being unable to plead, was ordered to be detained during Her Majesty's pleasure. (*Ibid.*, page 67.)

Police Station, Whittingham, Northumberland. — 18 *November.*—Some glass was broken, and a small hole made in the station yard, by an explosion which was attributed to a person who had been recently prosecuted by the police. (*Ibid.*, page 67.)

Yorkshire, West Riding. — 27 *November.*—Several attempts at outrages were made by, it was believed, some mischievous boys. (*Ibid.*, page 67.)

APPENDIX Q.

THE following SPECIAL REPORTS have been issued since the Act came into operation.

No.	Subject.	Date of Accident.	Date of Report.
I.	Report on the circumstances attending an Explosion of Dynamite at Cymmer, Glamorganshire (by Major Majendie, R.A.).	21 April 1876 -	24 May 1876.
II.	Report on the circumstances attending an Explosion of gunpowder at a Gunpowder Factory at Herodsfoot, Liskeard, Cornwall (by Major Majendie, R.A.).	12 May 1876 -	26 May 1876.
III.	Report on the circumstances attending an Explosion of Fulminate of Mercury at Hinks' Chemical Works, Small Heath, Birmingham (by Major Ford, R.A.).	14 May 1876 -	6 June 1876.
IV.	Report on the circumstances attending an Explosion of Dynamite at Burnbank, near Hamilton, N.B. (by Major Majendie, R.A.).	19 June 1876 -	1 September 1876.
IVA.	Report on the circumstances attending an Explosion of Fireworks at Norwich (by Major Majendie, R.A.).	12 September 1876	10 October 1876.
V.	Report on the circumstances attending an Explosion of Gunpowder at a Gunpowder Factory at Herodsfoot, Liskeard, Cornwall (by Major Ford, R.A.).	14 October 1876 -	9 November 1876.
VI.	Report on the circumstances attending an Explosion of Gunpowder at Hose Tunnel, near Scalford (by Major Ford, R.A.).	14 October 1876 -	21 December 1876
VII.	Report on the circumstances attending an Explosion of Tonite or Cotton Powder in a tunnel near Festiniog (by Major Majendie, R.A.).	26 January 1877 -	7 March 1877.
VIII.	Report on the circumstances attending an Explosion of a Floating Magazine moored on the River Thames below Gravesend (by Major Majendie, R.A.).	30 June 1877 -	10 August 1877.
IX.	Report on the circumstances attending an Explosion in the Factory of the Schultze Gunpowder Company (Limited), at Eyeworth, Hants (by Major Majendie, R.A.).	8 August 1877 -	1 September 1877.
X.	Report on the circumstances attending an Explosion of Gunpowder at No. 57, High Street, Bedford (by Major Ford, R.A.).	28 August 1877 -	24 September 1877.
XI.	Report on the circumstances attending an Explosion in a tunnel near Festiniog (by Major Ford, R.A.).	23 August 1877 -	29 September 1877.
XII.	Report on the circumstances attending an Explosion in the Factory of the Schultze Gunpowder Company (Limited), at Eyeworth, Hants (by Major Majendie, R.A.).	12 November 1877	24 December 1877.
XIII.	Report on the circumstances attending an Explosion in the Detonator Factory of the Cotton Powder Company (Limited), at Uplees Marshes, near Faversham (by Major Majendie, R.A.).	12 February 1878	6 March 1878.
XIV.	Report on the circumstances attending an Explosion in a Tunnel in course of construction at Halkyn, near Holywell (by Major Ford, R.A.).	10 April 1878 -	28 June 1878
XV.	Report on the circumstances attending two Explosions at Yarlside Mines, Parkhouse, Barrow-in-Furness (by Major Ford, R.A.).	14 May and 3 July 1878.	27 July 1878.
XVI.	Report on the circumstances attending an Explosion by Lightning of a Gunpowder Store at Victoria Colliery, Bruntcliffe (by Major Majendie, R.A.).	6 August 1878 -	17 September 1878
XVII.	Report on the circumstances attending an Explosion in Mr. MacDonald's War Rocket Factory at Whitehill, near Gravesend (by Major Majendie, R.A.).	13 September 1878	30 September 1878.
XVIII.	Report on the circumstances attending an Explosion of Dynamite in Carn Brea Mine, Redruth (by Major Majendie, R.A.).	27 September 1878	30 October 1878.

No.	Subject.	Date of Accident.	Date of Report.
XIX.	Report on the circumstances attending an Explosion of Gunpowder at a Gunpowder Factory at Elterwater, near Ambleside, Westmoreland (by Major Ford, R.A.).	29 November 1878	28 December 1878.
XX.	Report on the circumstances attending an Explosion of Dynamite at Deep Level Mine, Halkyn, near Holywell (by Major Ford, R.A.).	9 January 1879 -	12 February 1879.
XXI.	Report on the circumstances attending an Explosion of the Press House of Mr. Sharp's Gunpowder Factory at Chilworth, near Guildford (by Major Majendie, R.A.).	10 February 1879	20 February 1879.
XXII.	Report on the circumstances attending an Explosion of a Glazing House in Messrs. Hall's Gunpowder Factory at the Marsh, Faversham (by Major Majendie, R.A.).	21 February 1879	17 March 1879.
XXIII.	Report on the circumstances attending an Explosion of Gunpowder in the Extracting House of the Gunpowder Factory of Messrs. Pigou, Wilks, & Laurence (Limited), at Dartford (by Major Majendie, R.A.).	11 March 1879 -	31 March 1879.
XXIV.	Report on the circumstances attending an Accident which occurred in the Detonator Factory of Nobel's Explosives Company (Limited), at Redding, West Quarter, near Falkirk (by Major Majendie, R.A.).	12 May 1879 -	24 May 1879.
XXV.	Report on the circumstances attending an Explosion which occurred in the Detonator Factory of the Cotton Powder Company (Limited), at Uplees Marshes, near Faversham (by Major Ford, R.A.).	16 May 1879 -	23 June 1879.
XXVI.	Report on the circumstances attending an Accident in the use of Dynamite in a Tunnel in course of construction under the River Severn (by Major Ford, R.A.).	23 September 1879	30 October 1879
XXVII.	Report on the circumstances attending an Explosion of Gunpowder at a House at Pentre, Broughton, near Wrexham (by Major Ford, R.A.).	30 October 1879 -	19 November 1879.
XXVIII.	Report on the circumstances attending an Explosion which occurred in the Detonator Factory of Nobel's Explosives Company (Limited), at Redding, West Quarter, near Falkirk (by Major Majendie, R.A.).	13 October 1879 -	26 November 1879.
XXIX.	Report on the circumstances attending an Explosion of Gunpowder in Doncaster (by Major Majendie, R.A.).	3 January 1880 -	23 January 1880.
XXX.	Report on the circumstances attending an Explosion of Nitro-Glycerine (from Dynamite), at a Railway Cutting at Craig, near Montrose (by Major Ford, R.A.).	5 March 1880 -	30 March 1880.
XXXI.	Report on the circumstances attending an Explosion of Gunpowder in a Glazing House at Messrs. John Hall & Son's Gunpowder Factory at the Marsh, Faversham (by Lieut.-Col. Majendie, C.B., R.A.).	11 December 1880	21 February 1881.
XXXII.	Report on the circumstances attending an Explosion of Gunpowder and Blasting Cartridges at Messrs. John Hall & Son's Cartridge Factory at Eastwood, near Nottingham (by Major Ford, R.A.).	14 January 1881 -	9 March 1881.
XXXIII.	Report on the circumstances attending an Explosion of Gunpowder at a Gunpowder Factory at Blackbeck, Haverthwaite, Lancashire (by Lieut.-Col. Majendie, C.B., R.A.).	19 March 1881 -	5 April 1881.
XXXIV.	Report on the circumstances attending an Explosion of Dynamite and Blasting Gelatine in the Minera Mines, near Wrexham (by Lieut.-Col. Majendie, C.B., R.A.).	23 March 1881 -	14 May 1881.
XXXV.	Report on the circumstances attending an Explosion of Dynamite on the River Clyde, off Garvel Point, near Greenock (by Major Ford, R.A.).	16 April 1881 -	17 May 1881.
XXXVI.	Report on the circumstances attending an Explosion in Messrs. C. T. Brock & Co.'s Firework Factory at South Norwood (by Lieut.-Col. Majendie, C.B., R.A.).	24 May 1881 -	15 July 1881.

No.	Subject.	Date of Accident.	Date of Report.
XXXVII.	Report on the circumstances attending an Explosion of Gunpowder at a Press-house of a Gunpowder Factory at Gatebeck, near Kendal (by Major Ford, R.A.).	21 July 1881 -	11 August 1881.
XXXVIII.	Report on the circumstances attending an Explosion at a small Firework Factory at Nechells' Park Road, Birmingham (by Major Ford, R.A.).	17 August 1881 -	15 October 1881.
XXXIX.	Report on the circumstances attending the Burning and Explosion of a quantity of Fireworks in a Dwelling-house in Hanley (by Colonel Majendie, C.B.).	6 March 1882 -	19 June 1882.
XL.	Report on the circumstances attending an Explosion on Premises occupied by Mr. William Riley, Albumen Manufacturer, Drysalter, &c., in Henry Street, Castleton, near Manchester (by Captain Cundill, R.A.).	19 April 1882 -	20 June 1882.
XLI.	Report on the circumstances attending an Explosion in the Factory of Nobel's Explosives Company (Limited), at Ardeer, near Stevenston, in Ayr (by Captain Cundill, R.A.).	8 June 1882 -	29 June 1882.
XLII.	Report on the circumstances attending an Explosion at the Hull Botanic Gardens (by Captain Cundill, R.A.).	25 September 1882	6 November 1882.
XLIII.	Report on the circumstances attending an Explosion of Wet Tonite or Cotton Powder during the operation of pressing the same into Blasting Cartridges at the Works of the Cotton Powder Co. (Limited), at Uplees Marshes, near Faversham (by Colonel Majendie, C.B.).	5 November 1882 -	30 November 1882.
XLIV.	Report on the circumstances attending an Explosion in the Factory of Nobel's Explosives Company (Limited), at Ardeer, Ayrshire (by Captain Cundill, R.A.).	27 October 1882 -	9 December 1882.
XLV.	Report on the circumstances attending an Explosion in the Factory of the Potentite Company (Limited), at Melling, near Liverpool (by Lieut.-Col. Ford, R.A.).	15 July 1882 -	28 November 1882.
XLVI.	Report on the circumstances attending an Explosion which occurred during the Manufacture of Fog Signals at Messrs. Dyer & Robson's Ammunition Factory in Greenwich Marshes (by Colonel Majendie, C.B.).	28 November 1882	8 December 1882.
XLVII.	Report on the circumstances attending an Explosion at the Askham Iron Furnaces near Barrow-in-Furness (by Captain Cundill, R.A.).	8 December 1882 -	30 December 1882.
XLVIII.	Report on the circumstances attending two Explosions at the Factory of the Explosives Company (Limited), at Pembrey Burrows, Carmarthenshire (by Colonel Majendie, C.B.).	11 and 17 November 1882.	19 January 1883.
XLIX.	Report on the circumstances attending an Explosion in the Factory of the Potentite Company (Limited), at Conscough Bridge, near Melling, in Lancashire (by Captain Cundill, R.A.).	26 January 1883 -	10 March 1883.
L.	Report on the circumstances attending three Explosions in Glasgow (by Colonel Majendie, C.B.).	20 and 21 January 1883.	14 March 1883.
LI.	Report on the circumstances attending two Explosions in London at the Offices of the Local Government Board in Whitehall, and of the "Times" Newspaper in Play House Yard respectively (by Colonel Majendie, C.B.).	15 March 1883 -	27 April 1883.
LII.	Report on the circumstances attending an Explosion of Gunpowder and Blasting Cartridges at the Factory of the New Sedgwick Gunpowder Company (Limited), at Sedgwick, near Kendal (by Lieut.-Col. Ford, R.A.).	12 April 1883 -	30 April 1883.
LIII.	Report on the circumstances attending an Explosion by lightning at the Bassinghyll Gunpowder Mills (by Captain Cundill, R.A.).	15 June 1883 -	30 June 1883.
LIV.	Report on the circumstances attending an Explosion at the James Watt Dock, Greenock (by Colonel Ford).	16 August 1883 -	19 September 1883.
LV.	Report on the circumstances attending two Explosions on the Underground Railway, London (by Colonel Majendie, C.B., and Captain Cundill, R.A.).	30 October 1883 -	17 November 1883.

No.	Subject.	Date of Accident.	Date of Report.
LVI.	Report on the circumstances attending an Explosion at the Gunpowder Factory of Messrs. John Hall & Son, at Furnace, Lochfyne, near Inveraray (by Colonel Ford).	29 September 1883	5 December 1883.
LVII.	Report on the circumstances attending an Explosion at the Chilworth Gunpowder Factory (by Colonel Majendie, C.B.).	15 November 1883	5 December 1883.
LVIII.	Report on the circumstances attending an Explosion of Dynamite at the Town Hill Colliery, Dunfermline (by Colonel Majendie, C.B.).	17 December 1883	31 December 1883.
LIX.	Report on the circumstances attending an Explosion of Dynamite at the Victoria Railway Station, Pimlico, and attempted Explosions at the Charing Cross, Paddington, and Ludgate Hill Railway Stations (by Colonel Majendie, C.B., and Colonel Ford).	26 February 1884	8 March 1884.
LX.	Report on the circumstances attending an Explosion on Board the Steamer "Aberdeen," off Gravesend (by Major Cundill, R.A.).	1 March 1884 -	13 March 1884.
LXI.	Report on the circumstances attending an Explosion of Dynamite in a Cartridge Hut at the Factory of Nobel's Explosives Company (Limited), at Ardeer, Ayrshire (by Colonel Ford).	8 May 1884 - -	31 May 1884.
LXII.	Report on the circumstances attending Explosions of Dynamite in Scotland Yard and St. James' Square, and an attempted Explosion in Trafalgar Square (by Colonel Majendie, C.B., and Colonel Ford).	30 May 1884 -	10 June 1884.
LXIII.	Report on the circumstances attending an Explosion at a small Firework Factory at Wisbech (by Major Cundill, R.A.).	23 June 1884 -	5 July 1884.
LXIV.	Report on the circumstances attending an Explosion of Gunpowder at a Gunpowder Factory at Blackbeck, Haverthwaite, Lancashire (by Colonel Ford).	26 July 1884 -	30 August 1884.
LXV.	Report on the circumstances attending an Explosion on board a Steamer off Bournemouth (by Colonel Majendie, C.B.).	20 August 1884 -	17 September 1884.
LXVI.	Report on the circumstances attending an Explosion at the Worsborough Dale Gunpowder Factory (by Colonel Ford).	15 October 1884 -	23 October 1884.
LXVII.	Report on the circumstances attending an Explosion on Premises occupied by Mr. Joseph Balkwill, Chemist and Druggist, at Kingsbridge, Devon (by Major Cundill, R.A.).	30 October 1884 -	10 November 1884.
LXVIII.	Report on the circumstances attending an Explosion at Edenburn, the Private Residence of Mr. S. M. Hussey, in the county of Kerry (by Colonel Ford).	28 November 1884	5 December 1884.
LXIX.	Report on the circumstances attending an Explosion at Larne (by Major Cundill, R.A.).	5 February 1885 -	19 February 1885.
LXX.	Report on the circumstances attending an Explosion at Mr. Jas. Pain's Firework Factory, near Mitcham (by Major Cundill, R.A.).	16 May 1885 -	29 May 1885.
LXXI.	Report on the circumstances attending an Explosion at the Roslin Gunpowder Mills, near Edinburgh (by Major Cundill, R.A.).	9 July 1885 - -	27 July 1885.
LXXII.	Report on the circumstances attending an Explosion at the Gunpowder Factory of Messrs. Pigou, Wilks, and Laurence (Limited), at Dartford (by Colonel Majendie, C.B.).	21 August 1885 -	5 September 1885.
LXXIII.	Report on the circumstances attending an Explosion of Dynamite at the Mancetter Bridge Quarry, near Atherstone, Warwickshire (by Major Cundill, R.A.)	12 January 1886 -	30 January 1886.
LXXIV.	Report on the circumstances attending an Accident from the effects of fired Gunpowder, which occurred at Crarae Quarry, Loch Fyne (by Colonel Ford).	25 September 1886	12 November 1886.
LXXV.	Report on the circumstances attending an Explosion which took place at the Factory of Messrs. Kynoch & Co. (Limited), near Birmingham (by Major Cundill, R.A.)	2 November 1886	29 November 1886.
LXXVI.	Report on the circumstances attending an Accident at a display of Fireworks at Batley (by Major Cundill, R.A.).	24 December 1886	31 December 1886.

No.	Subject.	Date of Accident.	Date of Report.
LXXVII.	Report on the circumstances attending an Explosion of Gunpowder at 134, High Street, Cradley Heath, co. Stafford, on the Registered Premises of Henry Mould, Ironmonger (by Major Cundill, R.A.).	7 April 1887 -	28 April 1887.
LXXVIII.	Report on the circumstances attending an Explosion which occurred in the Lower Glazing House of the Gunpowder Factory of Messrs. Curtis's and Harvey, at Hounslow (by Colonel Ford).	3 May 1887 -	31 May 1887.
LXXIX.	Report on the circumstances attending an Explosion which occurred at the Firework Factory of Mr. John Hodsman, at Love Lane West, Dublin (by Colonel Ford).	24 May 1887 -	19 July 1887.
LXXX.	Report on the circumstances attending an Explosion of Fireworks at Messrs. Dyer and Robson's Factory, in Greenwich Marshes (by Colonel Majendie, C.B.).	11 June 1887 -	30 June 1887.
LXXXI.	Report on the circumstances attending a Fire and Explosion at Messrs. Roberts, Dale, and Company's Chemical Works, Cornbrook, near Manchester (by Colonel Majendie, C.B.).	22 June 1887 -	15 August 1887.
LXXXII.	Report on the circumstances attending an Explosion which took place in an Incorporating Mill at Lowwood Gunpowder Works (by Major Cundill, R.A.).	6 September 1887	13 September 1887.
LXXXIII.	Report on the circumstances attending an Explosion of Gunpowder in a Press-house of the Kennall Vale Gunpowder Factory (by Major Cundill, R.A.).	7 November 1887	19 November 1887.
LXXXIV.	Report on the circumstances attending an Explosion of Gunpowder and Blasting Cartridges which occurred at the Factory of Messrs. Williamson & Co. (Limited), at Fernilee, near Whaley Bridge (by Major Cundill, R.A.).	21 March 1888 -	19 April 1888.
LXXXV.	Report on the circumstances attending an Explosion of Percussion Caps (Primers) at the Factory of Messrs. G. Kynoch & Co. (Limited), at Witton, near Birmingham (by Major Cundill, R.A.).	3 July 1888 -	31 July 1888.
LXXXVI.	Report on the circumstances attending an Explosion during the emptying of some 3-pr. Shells for Quick-firing Ammunition at Messrs. Kynoch & Co.'s (Limited) Ammunition Factory, at Witton, near Birmingnam (by Colonel Majendie, C.B.).	10 August 1888 -	22 August 1888.
LXXXVII.	Report on the circumstances attending an Explosion of Amorces or Toy-Caps in the Small Firework Factory of Mr. H. J. Cadwell, at Southfields, Wandsworth (by Major Cundill, R.A.).	3 August 1888 -	12 September 1888.
—	Report on the circumstances attending the destruction of the petroleum vessel "United" in Bristol Docks (by Colonel Majendie, C.B.).	21 November 1888	21 December 1888.
LXXXVIII.	Report on the circumstances attending an Explosion which occurred at Mr. James Pain's Firework Factory, near Mitcham (by Colonel Majendie, C.B.).	4 June 1889 -	22 June 1889.
LXXXIX.	Report on the circumstances attending an Explosion which occurred during the illegal manufacture of Quick-Firing Ammunition by Sir W. G. Armstrong, Mitchell, & Co. (Limited), of Elswick, in the Wherry "Fanny," on the River Tyne (by Colonel Ford).	3 October 1889 -	15 October 1889.
—	Report on the circumstances attending an Explosion of Gunpowder at a Cartridge Factory in the occupation of M. Ferdinand Corvilain, and a Fire of Petroleum which resulted therefrom, at Antwerp (by Colonel Ford).	6 September 1889	1 October 1889.
XC.	Report on the circumstances attending an Explosion of Detonators which occurred at the Factory of Nobel's Explosives Company (Limited), at Redding, West Quarter, near Falkirk (by Colonel Ford).	15 November 1889	28 December 1889.
XCI.	Report on the circumstances attending an Explosion of Gunpowder which occurred at the Roslin Gunpowder Factory near Edinburgh (by Colonel Ford).	22 January 1890 -	17 February 1890.

No.	Subject.	Date of Accident.	Date of Report.
XCII.	Report on the circumstances attending an Explosion of Nitro-Glycerine exuded from Dynamite, at the Colwill Quarry, near Egg-Buckland, Devonshire (by Major Cundill, R.A.).	18 February 1890 -	3 March 1890.
XCIII.	Report on the circumstances attending an Explosion which occurred at the Grin Quarries, Burbage, near Buxton (by Colonel Majendie, C.B.).	1 March 1890 -	25 March 1890.
XCIV.	Report on the circumstances attending an Explosion of Fireworks at Mr. James Pain's Firework Factory, near Mitcham (by Colonel Majendie, C.B.).	6 July 1890 -	24 July 1890.
XCV.	Report on the circumstances attending an Explosion of Gunpowder which occurred at the Gunpowder Factory at Roslin, near Edinburgh (by Colonel Ford).	22 October 1890 -	12 November 1890.
XCVI.	Report on the circumstances attending an Explosion of Gunpowder which occurred at the Kames Gunpowder Factory (by Lieut.-Colonel Cundill, R.A.).	11 September 1891	26 September 1891.
XCVII.	Report on the circumstances attending an Explosion of Fireworks which occurred on board a Floating Magazine below Gravesend (by Colonel Majendie, C.B.).	11 January 1892 -	1 February 1892.
XCVIII.	Report on the circumstances attending Ignition and Partial Explosion of Gelatine Dynamite at Nant-y-Mwyn Lead Mine, Carmarthenshire (by Lieut.-Colonel Cundill).	28 March 1892 -	19 April 1892.
XCIX.	Report on the circumstances attending an Explosion in small Firework Factory at Coseley (by Lieut.-Colonel Cundill).	6 August 1892 -	19 August 1892.
C.	Report on the circumstances attending an Explosion on Board the "Auchmountain" on the River Clyde (by Lieut.-Colonel Cundill).	3 September 1892	12 September 1892.
CI.	Report on the circumstances attending an Explosion at Roslin Gunpowder Factory (by Colonel Majendie, C.B.).	17 September 1892	31 October 1892.
CII.	Report on the circumstances attending an Explosion at a small Firework Factory at Barton Moss, near Manchester (by Lieut.-Colonel Cundill).	26 October 1892 -	1 November 1892.
CIII.	Report on the circumstances attending an Explosion in Messrs. C. T. Brock & Co.'s Firework Factory at South Norwood (by Colonel Majendie, C.B.).	13 March 1893 -	24 April 1893.
CIV.	Report on the circumstances attending the destruction by Explosion and Fire of a Drying-House at the Factory of the Smokeless Powder Co., Limited (by Colonel Majendie, C.B.).	26 May 1893 -	20 June 1893.
CV.	Report on the circumstances attending an Explosion which occurred at Messrs. C. T. Brock & Co.'s Firework Factory at South Norwood (by Captain Thomson, R.A.).	19 August 1893 -	9 September 1893.
CVI.	Report on the circumstances attending an Explosion of Dynamite which occurred at Sutton Harbour, Plymouth (by Captain Thomson, R.A.).	13 December 1893	18 December 1893.
CVII.	Report on the circumstances attending an Explosion which occurred at the Ammunition Factory of Messrs. F. Joyce & Co., Limited, at Waltham Abbey (by Colonel Majendie, C.B.).	22 December 1893	30 December 1893.
CVIII.	Report on the circumstances attending an Explosion of Tonite or Cotton Powder which took place in the Solent (by Colonel Ford).	19 July 1894 -	30 July 1894.
CIX.	Report on the circumstances attending an Explosion which occurred in a Mixing House at the Factory of the National Explosives Company, Limited, at Upton Towans, Gwythian, near Hayle (by Colonel Ford).	4 September 1894	22 October 1894.
CX.	Report on the circumstances attending an Explosion which occurred on Registered Premises at No. 13, Blackwellgate, Darlington (by Captain Thomson, R.A.).	9 October 1894 -	25 October 1894.

APPENDIX R.

EXPLOSIVES ACT, 1875. (38 Vict. cap. 17.)

MEMO. Home Office, Whitehall, S.W.,
January 1, 1888.

When an inventor desires a new Explosive to be placed on the list of "Authorized Explosives" with a view to its being ultimately licensed for manufacture or importation, the steps to be taken are as follows:—

(*a.*) The inventor (or his agent) must write stating (confidentially if preferred) the exact composition of the explosive he proposes to submit* and the name by which it is to be distinguished.

This done, the applicant will be informed as to the amount of fee payable for the examination of the same under the scale of fees laid down by the Secretary of State. This fee will then have to be deposited at the Home Office and will *not* be returned whether the result of the examination is or is not favourable to the introduction of the explosive.

(*b.*) The inventor will then be asked to submit samples (the required amount being stated), and when he reports them ready a special permit for their conveyance will be sent to him.†

(*c.*) The general result of the examination will be communicated to the inventor. If it is found that the explosive is likely to be reasonably safe under ordinary conditions of manufacture, transport, and use, and especially that it is not too sensitive to friction or percussion, or a combination of these, an application for a license to manufacture or import the same will be entertained.

If, however, the explosive fails to comply with the above conditions, it will not be placed on the list of authorised explosives.

(Signed) V. D. MAJENDIE, Colonel,
H.M. Chief Inspector of Explosives.

APPENDIX S.

Home Office, Whitehall, S.W.,
March 8, 1894.

In forwarding a copy of the Report‡ which I recently made to the Secretary of State on a fatal explosion which occurred at the ammunition factory of Messrs. Joyce and Co., Limited, at Waltham Abbey, on the 22nd December 1893, I think it desirable to call your attention to the importance which the circumstances of this accident disclose, of substituting for the "hand" mixing system, wherever it is employed, a system which (like that which is described in this Report as the "jelly bag" mixing system) would not only tend to diminish in some degree the risk of accident, but also ensures the efficient protection of the workperson in the event of such an accident occurring. The "jelly bag" system, as described in my Report, has, as perhaps you are aware, been already wholly or partly adopted in some private factories, but I feel in the strongest way that the time has come when the system of mixing cap composition by hand should be entirely abandoned in favour of some such system as that referred to above. I shall, therefore, be glad to be informed at your early convenience whether, in view of the circumstances of the recent accident as set forth in this Report, and the satisfactory experience which has been obtained of the value and efficiency of the "jelly bag" mixing system, you will be prepared, in the event of your not having already done so, to take steps to entirely substitute this or some not less efficient arrangement for hand mixing. Of course, these observations will not affect cases where the composition is mixed wet, and in a comparatively inexplosive condition.

I have the honour to be,
Your obedient Servant,
(Signed) V. D. MAJENDIE, Colonel,
H.M. Chief Inspector of Explosives.

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* A copy of the Patent Specification should be sent where practicable.
† When the samples have to be imported from abroad, an Importation License will be required.
‡ Special Report, No. CVII.

APPENDIX T (*a*).

Prosecutions (Government Cases).

Date of Hearing.	Place of Hearing.	Name of Offender.	Act under which Proceedings were taken.	Number of Information.	Nature of Offence.	Result of Hearing.	Amount of Penalty. £ s. d.	Amount of Costs. £ s. d.	Amount of Forfeiture or Penalty in lieu. £ s. d.	Remarks.
1894. 12 March	Clerkenwell Police Court	Henry Jones, 302, Holloway Road, N.	Explosives Act, 1875.	1	Sending a case containing fireworks for conveyance by rail improperly marked.	Convicted	10 0 0	0 2 0	—	*See* also Accident 1 (Appendix W.)
28 March	Goole	Lancashire Explosives Company, Limited, 2, Albert Street, Manchester. (Magazine, No. 475, Yorkshire.)	Do.	1	Entering magazine in ordinary boots with iron nails.	Do.	1 0 0	1 4 3	—	
				2	Using iron or steel hammer and chisel in magazine.	Do.	1 0 0	1 4 3	—	
				3	Steel shovel in magazine	Do.	1 6 0	1 4 3	—	
				4	Explosive other than detonators in detonator annexe.	Do.	1 1 0	0 9 3	—	
21 April	Dartford	B. T. Moore, Longwood, Bexley, Kent. (Factory No. 138, Kent.)	Do.	1	Employing a boy under 16 in a danger building not under the supervision of a grown-up person.	Do.	5 0 0	0 19 0	—	
24 November	Castle Eden	John Percy Smith, Trimdon Grange, Ferryhill. (Magazine No. 132, Durham).	Do.	1	Floor of magazine not kept free from grit or clean.	Do.	3 0 0	0 17 6	—	
					Carried Forward		22 1 0	6 0 6	—	

PROSECUTIONS (GOVERNMENT CASES)—*continued.*

Date of Hearing.	Place of Hearing.	Name of Offender.	Act under which Proceedings were taken.	Number of Information.	Nature of Offence.	Result of Hearing.	Amount of Penalty.	Amount of Costs.	Amount of Forfeiture or Penalty in lieu.	Remarks.
1894.					Brought Forward - - - -		£ s. d. 22 1 0	£ s. d. 6 0 6	£ s. d. —	
24 November	Castle Eden -	John Percy Smith, Trimdon Grange, Ferryhill. (Magazine No. 132, Durham).	Explosives Act, 1875.	2	General rules not affixed in the magazine -	Convicted -	3 0 0	0 17 6	—	—
				3	Not making due provision by the use of suitable shoes, etc. to prevent the introduction of grit into the magazine.	Do. -	3 0 0	0 17 6	—	—
				4	Not taking due precautious to prevent unauthorised persons having access to the magazine.	Do. -	3 0 0	0 17 6	—	—
17 December	Tamworth -	Charles Henry Dent, Tamworth. (Bogus Bomb Scare).	Do. - -	1 to 24 -	Sending 24 bombs, fitted with percussion caps, for conveyance by rail, improperly packed and marked.	Do. -	24 0 0	—	—	1*l.* on each summons.
				25 to 48	Sending the same for conveyance by rail without due notice to the railway company.	Do. -	24 0 0	—	—	Do.
		Frank Cannock, Tamworth. (Bogus Bomb Scare).	Do. - -	1 to 24 -	Sending 24 bombs, fitted with percussion caps, for conveyance by rail, improperly packed and marked.	Do. -	24 0 0	—	—	Do.
				25 to 48	Sending the same for conveyance by rail without due notice to the railway company.	Do. -	24 0 0	—	—	Do.
					Total - - - -		127 1 0	8 13 0	—	

APPENDIX T (*b*).

PROSECUTIONS (LOCAL AUTHORITY CASES).

Date of Hearing.	Place of Hearing.	Name of Offender.	Act under which Proceedings were taken.	Number of Information.	Nature of Offence.	Result of Hearing.	Amount of Penalty.	Amount of Costs.	Amount of Forfeiture or Penalty in lieu.	Remarks.
1894.							£ s. d.	£ s. d.	£ s. d.	
20 February -	Liverpool -	Messrs. Lamport and Holt, 21, Water Street, Liverpool (steamship owners).	Explosives Act, 1875.	1	Bringing three cases of amorces into the Alexandra Dock, Liverpool, in the SS. "Herschel," and landing the same in breach of the byelaws of the Mersey Docks and Harbour Board.	Convicted -	5 0 0	0 4 6	—	
				2	Depositing the same in the shed on the north side of No. 1, Alexandra Branch Dock, without giving notice thereof to the dock master.	Do. -	2 0 0	0 4 6	—	
27 February -	Wells, Somerset	J. N. Knight, Ironmonger, High Street, Wells. (Registered premises, No. 1,342.)	Do. -	1	Keeping 349 lbs. of gunpowder and 18 lbs. of S.S. smokeless powder in an unauthorised place.	Do. -	2 0 0	3 10 0	165 lbs. gunpowder.	3*l.* 3*s.* allowed for the expenses of the Government Inspector.
16 July -	Kilrush - -	John C. Mahony, Market Square, Kilrush. (Registered premises No. 150.)	Do. -	1	Having an excess of 40 lbs. of gunpowder on his registered premises.	Do. -	—	0 1 6	—	The defendant was directed to provide a suitable fireproof safe for keeping the gunpowder, and no penalty was inflicted.
				2	Having more than 1 lb. of gunpowder not in a substantial bag, case, or other receptacle made and closed so as to prevent the gunpowder from escaping.	Do. -	—	0 1 6	—	
				3	Having a receptacle for the gunpowder not so lined or covered as to prevent the exposure of iron or detachment of grit.	Do. -	—	0 1 6	—	
						Carried Forward -	9 0 0	4 3 6	165 lbs. gunpowder.	

Date of Hearing.	Place of Hearing.	Name of Offender.	Act under which Proceedings were taken.	Number of Information.	Nature of Offence.	Result of Hearing.	Amount of Penalty.	Amount of Costs.	Amount of Forfeiture or Penalty in lieu.	Remarks.
1894.					Brought Forward		£ s. d. 9 0 0	£ s. d. 4 3 6	£ s. d. 165 lbs. gunpowder.	
16 July	Kilrush	John Madigan, Market Square, Kilrush. (Registered premises, No. 149.)	Explosives Act, 1875.	1	Having a receptacle for the gunpowder on his registered premises not so lined or covered as to prevent the exposure of iron or detachment of grit.	Convicted	—	0 1 6	—	The defendant was directed to provide a suitable fire-proof safe for keeping the gunpowder, and no penalty was inflicted.
				2	Having more than 1 lb. of gunpowder not in a substantial bag, case, or other receptacle made and closed so as to prevent the gunpowder from escaping.	Do.	—	0 1 6	—	
7 August	Carlisle	Thomas Harrison, Bank Street, Carlisle. (Registered premises No. 1,306.)	Do.	1	Having an excess of explosive on his registered premises.	Do.	0 10 6	0 8 0	—	
				2	Having more than 5 lbs. of gunpowder in the room used for filling cartridges in connexion with the said premises.	Do.	0 10 6	0 8 0	—	
31 August	Perth	David M. Stuart, Main Road, Pitlochry. (Registered premises No. 2,395.)	Do	1	Keeping gunpowder in an unauthorised place.	Do.	0 5 0	1 19 0	100 lbs. of gunpowder.	
11 October	Gateshead	William Rochester (Store No. 1,354.)	Do.	1	Keeping gelignite in an unauthorised place.	Do.	—	0 7 0	—	Ordered to pay costs.
26 October	Falkirk	John Denholm, Thorn Farm, Larbert, Falkirk. (P.N.C. No. 349.)	Do.	1	Keeping 2,487½ lbs. of explosives in an unauthorised place.	Do.	25 0 0	—	—	
3 November	Alnwick	Mark Appleby, Embleton (P.N.C. No. 350.)	Do.	1	Keeping cartridges for blasting made with carbonite in an unauthorised place.	Do.	1 0 0	0 12 0	—	
					Carried Forward		36 6 0	8 0 6	265 lbs. gunpowder.	

Prosecutions (Local Authority Cases)—*continued.*

Date of Hearing.	Place of Hearing.	Name of Offender.	Act under which Proceedings were taken.	Number of Information.	Nature of Offence.	Result of Hearing.	Amount of Penalty.	Amount of Costs.	Amount of Forfeiture or Penalty in lieu.	Remarks.
1894.					Brought Forward -	- - -	£ s. d. 36 6 0	£ s. d. 8 0 6	£ s. d. 265 lbs. gunpowder.	
7 November -	Margate -	Thomas Bentley & Co., High Street, Margate. (Registered premises No. 2,081.)	Explosives Act, 1875.	1	Keeping fireworks and cartridges for sale on unregistered premises.	Convicted -	2 0 0	0 7 0	—	
27 November	Canterbury -	John Stoakes, 27, St. Peter's Street, Canterbury. (Registered premises No. 2,409.)	Do. -	1	Having an excess of 108 lbs. of explosives on his registered premises.	Do. -	1 7 0	0 10 6	—	
5 December -	Ringwood -	Henry Rose, Market Place, Ringwood. (Registered premises No. 2,413.)	Do. -	1	Having an excess of 185 lbs. of gunpowder on his registered premises.	Do. -	0 1 0	0 7 0	185 lbs. of gunpowder.	
				2	Keeping S.S. powder and E.C. powder in an unauthorised place.	Do. -	0 1 0	0 7 0	15 lbs. of S.S. powder and 7 lbs. of E.C. powder.	
20 December	Bournemouth -	Alfred Henry Lightwood, 88, Old Christchurch Road, Bournemouth. (Registered premises No. 2,414).	Do. -	1	Having an excess of 67½ lbs. of gunpowder on his registered premises.	Do.	1 0 0	0 10 0	—	
				2	Keeping Schultze gunpowder and S.S. powder in an unauthorised place.	Withdrawn	—	—	—	Costs paid by the defendant.
31 December	Tonypandy -	Robert T. Jones, Ironmonger, Treherbert. (*See* Accident No. 94.)	Do. -	1	Selling gunpowder to a child apparently under the age of 13 years.	Dismissed -	—	—	—	
					Total - - -		40 15 0	10 2 0	450 lbs. gunpowder. 15 lbs. S. S. powder. 7 lbs. E. C. powder.	

APPENDIX U.

Seizures of Explosives effected during the Year 1894.

Index No.	Owner or Occupier.		Date of Seizure.	Where seized.		Officer by whom Seizure was made.	Explosive, &c. seized.	Home Office Registry No.	How disposed of.
	Name.	Address.		County.	Place.				
1	Knight, J. N.	High Street, Wells	1894. 19 Feb.	Somerset	Registered Premises, No. 1,342.	Colonel Ford	Gunpowder, 349 lbs. S.S. Powder, 18 lbs.	—	Prosecuted, convicted, and fined. *See* Appendix T(*b*).
2	Cotton Powder Co., Limited	116, Queen Victoria Street, E.C.	3 April	Kent	Factory No. 7	Do.	Tonite No. 3, 90 lbs.	—	Released, 10th April.
3	Maxim-Nordenfelt Guns and Ammunition Co., Limited.	32, Victoria Street, S.W.	1 May	Do.	River Thames	Colonel Majendie, C.B.	B. N. Powder, 3 cwt., 3 qrs., 9 lbs.	X 19,635	Imported under License 504*a*. Released for return to port of origin.
4	The Lowwood Gunpowder Co.	Lowwood	30 May	Lancashire	Factory No. 23	Do.	Gunpowder, 420 lbs.	—	Released, 8th June. The offending workman fined 10*s*. by the Company.
5	Baker, T. & G.	124, Sewardstone Road, Victoria Park, E.	12 June	Essex	Factory No. 108	Colonel Ford	Manufactured Fireworks, 650 lbs.	—	Released on taking out an Amending License.
6	Turner, F.	Plas Brereton	21 June	Carnarvon	P.N.C. 348, Extinct Magazine No. 21.	Captain Thomson, R.A.	Compressed cartridges, 50 lbs.	—	Released on payment of police expenses.
7	Madigan, J.	15, Market Square, Kilrush	27 June	Clare	Registered Premises, No. 149.	Colonel Ford	Gunpowder, 35 lbs.	—	Prosecuted and convicted. *See* Appendix T (*b*).
8	Mahony, J. C.	21, and 22, Market Square, Kilrush.	27 June	Clare	Registered Premises, No. 150.	Do.	Gunpowder, 90 lbs.	—	Do. do.
9	Pain, James & Sons	121, Walworth Road, S.E.	18 July	Surrey	Factory No. 73	Colonel Majendie, C.B.	Manufactured fireworks, 100 lbs. Coloured stars, 99 lbs. Bright stars, 35 lbs.	—	Released on receipt of explanation, 30th July.
10	Hunter & Walker	66, Waterloo Street, Glasgow.	27 July	Lanark	Magazine No. 444.	Captain Thomson, R.A.	Detonators 14½ cases	—	Released, 9th August.

Seizures of Explosives effected during the year 1894—*continued.*

Index No.	Owner or Occupier.		Date of Seizure.	When seized.		Officer by whom Seizure was made.	Explosive seized.	Home Office Registry No.	How disposed of.
	Name.	Address.		County.	Place.				
11	Harrison, T.	Bank Street, Carlisle	1894. 1 August	Cumberland	Registered Premises, No. 1,306.	Colonel Ford	Schultze gunpowder. 16 lbs. E.C. gunpowder, 10½ lbs.	—	Prosecuted, convicted, and fined. *See* Appendix T (*b*).
12	Turner & Sons, T.	86, Northbrook Street, Newbury.	14 August	Berks	Registered Premises, No. 1,147.	Colonel Majendie, C.B.	Gunpowder, 10 lbs.	—	Released 25th August.
13	Stuart & Sons, C. C.	Main Road, Pitlochry	22 Aug.	Perth	Registered Premises, No. 2395.	Colonel Ford	Gunpowder, 100 lbs.	—	Prosecuted, convicted, and fined. *See* Appendix T (*b*).
14	Hodsman, J.	Love Lane West, Dublin	6 Sept.	Dublin	Factory No. 78	Colonel Majendie, C.B.	Gunpowder, 27 lbs	—	Destroyed.
15	Routledge, J.	Ferry Hill	5 Oct.	Durham	Registered Premises, No. 2,045.	Captain Thomson, R.A.	Electric detonator fuzes, 2,000	—	Released 8th October.
16	Bentley & Co., T.	3, High Street, Margate	2 Nov.	Kent	Registered Premises, No. 2,081.	Colonel Ford	Fireworks, 75 lbs.	—	Prosecuted, convicted, and fined. *See* Appendix T (*b*).
17	Manchester Ship Canal Co.	41, Spring Gardens, Manchester.	8 Nov.	Cheshire	Magazine No. 197.	Do.	Gunpowder, 1,375 lbs.	—	Released 5th December.
18	Stoakes, John	27, St. Peter's Street, Canterbury.	5 Dec.	Kent	Registered Premises. No. 2,409.	Do.	Schultze gunpowder, 15 lbs. S.S. powder, 10 lbs. Fireworks, 20 lbs.	—	Prosecuted, convicted, and fined. *See* Appendix T (*b*).
19	Rose, Henry	Market Place, Ringwood	29 Nov.	Hants	Registered Premises, No. 2,413.	Do.	Gunpowder, 185 lbs. S.S. powder, 15 lbs. E.C. powder, 7 lbs.	—	Prosecuted, convicted, and fined. *See* Appendix T (*b*).
20	Lightwood, A. H.	88, Old Christchurch Road, Bournemouth.	30 Nov.	Do.	Registered Premises, No. 2,414.	Do.	Gunpowder, 67½ lbs. S.S. powder, 14 lbs. Schultze powder, 5 lbs.	—	Prosecuted convicted, and fined. *See* Appendix T (*b*).

SEIZURES WITHOUT WARRANT.

15th October.—Seizure by Local Officer under Explosives Act, at Thorn Farm, Falkirk, of 2,487½ lbs. of blasting powder. The occupier, John Denholm, was prosecuted and fined 25*l*. (*See* Appendix T (*b*).)
12th November.—Seizure by Local Officer under Explosives Act, at 5, Gelli Crossing, Ystradyfodwg, of 4 lbs. of gelatine dynamite and detonators. The occupier, Isaac Biber, was prosecuted and fined 20*s*.

APPENDIX V.

COLLODION.

Home Office, Whitehall, S.W.,
25th April 1894.

GENTLEMEN,

SINCE the Explosives Act, 1875, came into operation the question has more than once been raised as to the position of collodion cotton, or, as it is sometimes called, soluble guncotton; and, as you are probably aware, we have until recently held that such material need not be reckoned as an explosive.

Further researches on the subject of the material have, however, disclosed the fact that its solubility may in some cases be associated with a certain explosibility, and under these circumstances it appears to us that soluble guncotton does, as a matter of fact, properly fall within the category of "explosive" as defined by the Explosives Act, 1875, and the Orders thereunder, except when its condition is such as to deprive it of its explosive properties, viz., when it is—

(*a.*) In solution in alcohol and ether; or

(*b.*) Wet; or

(*c.*) Saturated with methylated spirit, and contained in air-tight cases.

We have been in communication with the Customs on this subject, and we understand that they are issuing instructions to their officers to that effect. Of course this decision affects the manufacture, storage, and transport of soluble guncotton which does not fall within the exemptions specified above. Of course, when soluble guncotton is intended for use itself as an explosive (not merely as an ingredient of an explosive), it necessarily falls within the definition of an explosive, in virtue of section 3 of the Act, irrespective of the conditions under which it may exist.

I have, &c.
(Signed) V. D. MAJENDIE, Colonel,
H.M. Chief Inspector of Explosives.

Sent to manufacturers of explosives in which nitro-cellulose enters.

APPENDIX V (1).

Home Office, Whitehall, S.W.,
16th May 1894.

With reference to the circular which was sent out to the firework manufacturers generally, on the 11th October 1893, in which I invited an expression of opinion on the subject of the continued use of compositions containing or consisting of an admixture of sulphur and chlorate of potash, it is desirable that I should inform you that the result of this inquiry was to elicit a trade opinion, which, on the whole, may be regarded as distinctly favourable to the prohibition of such admixtures.

Under these circumstances, and having fully considered the matter with the chemical adviser of this Department, and in view of the numerous accidents which have resulted from chlorate-sulphur mixtures, I not only felt warranted, but deemed it my duty to submit to the Secretary of State the expediency of making an Order in Council which would prohibit chlorate-sulphur mixtures, except on condition that any such mixture was to be used only (if at all) with the consent of, and under conditions approved by a Government Inspector.

I now beg to enclose a copy of an Order in Council No. 15, dated 30th April 1894, prohibiting the manufacture, keeping, importation, conveyance, and sale of any firework containing an admixture of sulphur with chlorate of potassium or other chlorate, except with the consent of, and subject to conditions approved by a Government Inspector.

With a view to enabling the present stocks to be worked off, the Order will not come into effect, so far as keeping, conveyance, or sale are concerned, until the 1st January 1895; and it will, no doubt, be advisable that you should direct the attention of your customers to the terms of this Order, as far as it may affect their business.

In the case of manufacture, the Order will come into force at the expiration of one calendar month from the date of the Order; in other words, it will be unlawful, on and after the 1st June 1894, to manufacture any firework containing any sulphur-chlorate composition, unless you are able to satisfy Her Majesty's Inspectors of Explosives that there are grounds for exempting any particular firework which you may desire to manufacture from this prohibitive regulation, and subject to such conditions as Her Majesty's Inspectors of Explosives may in granting any such exemption deem it expedient to impose. The same will apply to fireworks proposed to be imported.

I have, &c.
(Signed) V. D. MAJENDIE, Colonel,
H.M. Chief Inspector of Explosives.

To all Firework Manufacturers.

APPENDIX V (2).

Home Office, Whitehall, S.W.,
9th August 1894.

GENTLEMEN,

I DO not know whether you are aware that the German Government has recently introduced some regulations with a view to securing the identification of individual cartridges (for blasting, &c.) containing dynamite and other "high explosives."

It cannot, I think, be doubted that it is extremely desirable to secure, if possible, this form of identification. Of course, so long as the cartridges are in their original boxes, no difficulty exists, provided the boxes are themselves correctly marked with the factory of origin, and the date; but directly the cartridges leave the boxes in which they were originally packed, which, of course, is liable to happen continually in the case of explosives provided for the use of mines, &c., and which must obviously happen in the case of cartridges being stolen, whether for purposes of outrage or for more innocent ends, all means of identification cease to exist, in the absence of some special system of marking individual cartridges. Also, I need hardly point out that in the event of any question arising as to the quality or condition of a cartridge, its identification as belonging to a batch manufactured on a particular date, or at a particular time, might be of very great service. I venture, therefore, to invite you to express your opinion as to the practicability of adopting in the case of explosives manufactured by you, some method by which the identification of the cartridge, with the particular factory, and date of manufacture, and with the particular box, will be established. In the German system, as you are perhaps aware, identification is effected in cipher by an ingenous arrangement which it is perhaps not necessary for me to detail, the object being to keep the marks of identification secret, which it is thought, in the case at any rate of thefts of cartridges, may be an advantage. Personally, I am disposed to doubt whether the advantages of the cipher system are sufficient to outweigh the somewhat complicated and elaborate method by which this secrecy is secured; and I should be disposed to think that all that is really necessary would be obtained by the simple plan of marking each cartridge with the name of the factory, the date of manufacture, and the number (or other identifying mark) of the box in which the cartridge is packed.

But, without wishing to dogmatise as to the particular mode of effecting that which I am anxious to see accomplished, but rather with a view to obtaining in the first instance the advantage of the experience and opinion of the trade, I desire to put the point before you, and ask you to favour me with your views on the question, and to state whether you will be prepared to adopt some arrangement to secure the identification of individual cartridges.

I have, &c.

(Signed) V. D. MAJENDIE, Colonel,
H.M. Chief Inspector of Explosives.

To all Manufacturers of High Explosives.

APPENDIX V (3).

Home Office, Whitehall, S.W.,
18th October 1894.

GENTLEMEN,

In consequence of two accidents which occurred at the Royal Laboratory, Woolwich, in the course of last summer, during the drumming of some percussion caps for "·303" cordite small-arm cartridges, we thought it expedient to carry out some experiments with a view to determine whether it was necessary to modify the conclusion at which we had arrived, as the result of former accidents and experiments, viz., that the dividing line between a "percussion cap" and a "detonator" (*see* Order in Council No. 1) might properly be drawn at 0·5 grains of composition, *i.e.*, where the cap contained a charge of over 0·5 grains of composition it should rank as a "detonator," below that as a "percussion cap" (*see* on this subject Annual Report of 1885, pages 69 and 117, and Annual Report of 1890, page 53).

The experiments which we carried out will be set forth in detail in the Annual Report for the current year ;* but as some months will necessarily elapse before that Report is completed, we have thought it desirable to inform you that the experiments appear to show that the foregoing distinction between caps and detonators is susceptible of some modification according to the character of the composition employed, and we are disposed to think that we should be justified in future in drawing the line between caps and detonators as follows:—

A "percussion cap" to be one containing a charge not exceeding ·5 grains of composition, or 0·6 grains of composition where the quantity of fulminate of mercury does not exceed a quarter of such composition; in any other case the cap will rank as a "detonator."

Of course this conclusion is liable to be modified by such further experience as may be acquired.

It is also, we think, important that we should bring to your notice the fact, already no doubt established, but not always sufficiently appreciated, that percussion caps when hot (as when freshly stoved, or in the course of being stoved) should be treated as so much cap composition (measured by their contents), rather than as so many caps not liable to explode *en masse*. And also, although perhaps it may seem superfluous to mention this, that an admixture of caps and loose composition, when hot or cold, should be treated in all cases as dangerously sensitive.

I have, &c.

(Signed) V. D. MAJENDIE, Colonel,
H.M. Chief Inspector of Explosives.

To all Ammunition Manufacturers.

* Page 79.

APPENDIX W.

ACCIDENTS by FIRE or EXPLOSION which have come under the notice of the Home Office from 1st January to 31st December 1894.

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons		Home Office Registry No.
					Killed.	Injured.	
	1894.						
*1	10 Jan.	Fireworks, viz., capillary tubes, containing sulphuric acid, enclosed in a small packet containing a mixture of chlorate of potassium, realgar, and sugar, wrapped in lightning paper.	Railway Receiving Office, No. 1A, Pentonville Road, Clerkenwell.	About 8.15 p.m. a man called at the office and left a parcel for transmission by the Midland Railway to Mr. Walton, Theatre Royal, Stockport. It was put into a cupboard, and about five minutes afterwards the contents exploded with a loud report, but without doing any damage, except to the parcel. The arrangement of the packet was one readily liable to cause fire or explosion, as the capillary tubes are very fragile, and if broken, the acid contained in them would come in contact with the chlorate mixture and cause its ignition, and the instant burning, if unconfined, or explosion, if confined, of the lightning paper. The articles are used in theatres for the production of sudden flashes of light of different colours. They were, therefore, fireworks within the meaning of the Explosives Act, and should have been marked externally with the word "Explosive," together with the name of the explosive and "Fireworks, Division 2." Proceedings were instituted against Henry Jones, trading as A. Jones & Co., resulting in a conviction and the infliction of a penalty of 10*l.* (*See* Appendix T (*a*)).	—	—	
2	22 Jan.	Tonite or cotton powder.	West Highland Railway in course of formation, Glenfalloch.	A "ganger" (about 50) was injured about the face, head, and eyes, by the explosion of tonite, while working in a cutting at Glenfalloch. The injured man refused to say in what way the accident occurred. It was supposed that he had been experimenting with the tonite, as, on several occasions it had not exploded in the way it should have done.	—	1	X. 45896
3	10 Jan.	Gunpowder	Edmondsley, near Durham, in the house of a miner.	A miner was putting some compressed cartridges into a tin box, when the candle he was carrying fell out of the candlestick and was extinguished. He struck a match to re-light it, and the match breaking in two, the lighted part fell into the tin box, causing the cartridges to explode. He was severely burnt, and died four days afterwards. Considerable damage was done to the room.	1	—	X. 45747
4	12 Jan.	Geliguite -	Huddersfield Corporation Water Works, Butterley Marsden, Yorkshire.	The deceased was working with three other men when he struck an old shot, which had missed fire some time previously, with his pick. It exploded with a loud report, killing him on the spot, and injuring the three others.	1	3	X. 45757

* *See* similar accident (No. 38, 1887), Annual Report for 1887, p. 117.

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons		Home Office Registry No.
					Killed.	Injured.	
	1894.						
5	18 Jan.	Blasting gelatine.	Glanrafon Slate Quarry, Beddgelert, Carnarvonshire.	The deceased, contrary to regulations, was clearing some dirt, with an iron scraper, from a hole which had partly missed fire. He succumbed to the injuries inflicted upon him by the explosion which followed. The coroner's jury returned a verdict to the effect that the deceased came to his death through his own negligence, whilst blasting with gelatine.	1	—	
6	24 Jan.	Ballistite -	Factory No. 155, Surrey. (The Chilworth Gunpowder Company, Limited.)	During the process of rolling a charge of ballistite it ignited, without causing any injury. The drenchers acted satisfactorily. No cause can be assigned for the ignition of the charge.	—	—	
7	13 Feb.	Gunpowder	Factory No. 24, Cornwall. (The East Cornwall Powder Company, Limited.)	Incorporating mills, Nos. 3 and 4, exploded without causing any personal injury, and with little damage to the building. The ground charges had been removed from both mills, and the bed plates were well wetted with water to soften the "clinkers" and incrustations prior to cleaning, and when the runners were being moved off the "clinkers," No. 3 exploded and communicated with No. 4.	—	—	
8	22 Feb.	Gunpowder	Johnson's Square, Haswell, Durham. House occupied by Henry Hughes, miner.	The wife of the occupier placed a lighted candle on a box which contained three compressed powder cartridges. The candle fell into the box and exploded the cartridges. She was seriously injured about the face. A few slates were blown off the house.	—	1	
9	23 Feb.	Gelatine dynamite.	Harras Moor, Whitehaven. House occupied by William Barnes.	The injured man, a collier, found some pieces of gelatine dynamite in the pit, and carried it in his pocket for some time. On the evening of the 23rd February, whilst sitting at home in front of the fire, he attached a short piece of fuze to a detonator, inserted it into the dynamite, and lit it with a cinder out of the fire. He tried to put the fuze out, but the dynamite exploded in his hands, with the result that he had both his hands blown off, his left eye blown out, and his face severely injured. Seven panes of glass were broken. Two of his children who were in the room fortunately escaped uninjured.	—	1	
10	21 Feb.	Ammonite -	Silverdale Colliery -	The accident was due to the blowing out of a shot consisting of a 6 oz. charge of ammonite. The shot was fired by a fuze and went off earlier than was expected, and before the two men engaged had time to get under cover. One man (who was in a direct line with the shot) was slightly scorched, the other man escaped injury.	—	1	X. 46389

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons		Home Office Registry No.
					Killed.	Injured.	
	1894.						
11	3 Mar.	Gunpowder	Eston Mines, Yorkshire.	A miner, on returning to see why his shot failed to go off, was fatally injured. (This was a breach of the special rules in returning to the shot too soon.)	1	—	X 46405
12	2 Mar.	Detonator -	Factory No. 18, Stirling. (Nobel's Explosives Company, Limited.)	A cap charger was slightly injured by the explosion of a detonator whilst removing it from the jig. As the man was infringing a special rule in touching the jig under the circumstances (it being the province of the chemist to extract detonators in such cases), he was immediately discharged.	—	1	
13	2 Mar.	Detonator -	Clowne Board School.	A little girl had the thumb and forefinger of her left hand blown off, and was otherwise injured by the explosion of a detonator, which she was pricking with a hair pin. Three other children, who were sitting near her, were slightly injured.	—	4	
14	3 Mar.	Dynamite -	Llest Colliery, Pontyr-hill, Garn Valley.	The deceased was preparing to thaw some dynamite, and had placed a tin (containing some water that had been used for thawing on the previous evening), on the fire. An explosion following, the man received fatal, and his two comrades slight, injuries. The tin evidently contained some nitro-glycerine, which had exuded on the previous thawing. This is one of those accidents which would have been avoided by the use of a proper warming pan.	1	2	X 46425
15	12 Mar.	Gunpowder	Factory No. 39, Faversham, Kent. (Messrs. John Hall and Son.)	Incorporating Mill No. 133 had been running only about two minutes, on a 60 lbs. charge, when the accident occurred (the charge having been "liquored" when put on.) No one was injured, and no damage was caused.	—	—	
16	13 Mar.	Gelignite -	Dolcoath Mine, Cornwall.	It was not ascertained exactly what happened. Apparently one charge of gelignite had gone off, and the deceased was engaged in preparing for the firing of a second charge when a second explosion occurred, which it seems, on the whole, most probable, was due to some unexploded portion of the last charge having in some way (perhaps by means of the workman's tools) been exploded, or the tool may have struck into some unexploded portion of some former charge.	1	1	X 46541
17	14 Mar.	Gelatine dynamite.	Llanberis Slate Quarry, Dinorwic.	A slate quarryman appears to have left his companions, stating that he was going into one of the barracks to *warm* a dynamite charge. He went into the room, and was there alone. Shortly afterwards an explosion was heard, and part of the roof was blown away, also the door. The deceased was found dead, the upper part of his body being blown to pieces. He had been engaged (notwithstanding the printed notices issued with the ex-	1	—	

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons		Home Office Registry No.
					Killed.	Injured.	
	1894.		Llanberis Slate Quarry, Dinorwic —*cont.*	plosive warning against the practice), in thawing gelatine dynamite in an improvised apparatus before (or over) a fire, such apparatus not being adapted to the purpose.			
18	19 Mar.	Electric detonator fuze.	Factory No. 138, Kent. (Mr. B. T. Moore.)	In pushing the wires through the priming on to the fulminate of the electric detonator fuze, an explosion occurred, by which a lad (aged 15) lost two fingers and part of the thumb of one hand, his face and other hand being slightly injured. Proceedings were instituted against the occupier of the factory for employing a boy under the age of 16, without being under supervision. A penalty of 5*l.* and costs, amounting to 19*s.*, was inflicted. (*See* Appendix T(*a*).)	—	1	
19	15 Mar.	Dynamite -	Kirkcaldy and District railway in course of formation.	Whilst a navvy was working with his pick at a spot where shortly before a dynamite charge had been fired; the pick came in contact with some unfired dynamite, the resulting explosion severely injuring him and another man who was working with him.	—	2	X 46770
20	10 April	Gunpowder	Factory No. 143, Edinburgh. (The Midlothian Gunpowder Company, Limited.)	Incorporating Mill No. 4 was working on a "green" charge of 80 lbs., when the accident took place. The wooden sides of the mill were blown out, and the roof was set on fire, but no further damage was done. No one was injured. The cause of the accident was not ascertained.	—	—	
21	14 April	Gunpowder	Factory No. 49, Middlesex. (Messrs. Curtis's and Harvey.)	Incorporating Mill No. 17 exploded on a 50 lb. charge of merchant gunpowder, after running 20 minutes. No one was injured, and no damage done. Cause of accident not ascertained.	—	—	
22	11 April	Detonator -	Craigneuk Colliery, New Monkland.	A lad aged 13 found a detonator on a railway siding on his way home from work. Whilst picking the detonator with a pin it exploded, and injured the thumb, first and second fingers, of each hand, and scorched his left cheek.	—	1	X 47089
*23	19 April	E. C. powder	Factory No. 122, Kent. (The E. C. Powder Company, Limited).	A fire (without any explosive results) took place in Building No. 20, during the operation of dusting E.C. powder. The fire originated in connexion with the sifting machinery. The building, which was of galvanized iron, was completely gutted, the roof fell in, and the testing machine was destroyed. The two men at work at the time escaped injury. There were about 500 lbs. of powder in the building, 30 lbs. of which were in the sifting machine, and the remainder in tin-plate bottles. The whole of the powder present was destroyed, but there was no explosion. The cause of the accident is ascribed either to grit, or to some portion of the sifting machine setting up a rubbing contact; but the exact cause, however, was not ascertained. It was possibly due to electricity generated in the dry powder.	—	—	

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	1894.						
24	28 April	Dynamite -	Thirlmere Water-works.	During some blasting operations in quarrying, a stone appears to have been blown out and struck the deceased, who was walking between some trees at some little distance from where the quarrying was being carried on.	1	—	X 47353
25	24 April	Gunpowder	Cliff Brickyard, Kingsbury.	A man was engaged in charging a hole with gunpowder, when an explosion occurred. He was severely burnt, and afterwards succumbed to his injuries. It was thought probable that he had carelessly left a box of loose powder near the hole, and this was ignited during the operation of lighting the fuze.	1	—	
26	1 May	Gunpowder	Chanter's Pit, Atherton.	A miner, in company with his mate, had lighted the fuzes of four shots, and had turned to run away, when the first shot, which had a two-foot fuze, exploded. His skull was fractured, and he died four days after.	1	—	
27	16 April	Dynamite -	Rannoch Muir, Perth.	The deceased was engaged, with another man, in charging boreholes with dynamite, and was in the act of stemming a charge with a wooden stemmer, when an explosion occurred, fatally injuring him. It appears to have been the practice to insert two *soft* cartridges in the bore hole and stem them, and next to introduce two hard ones. It was whilst stemming the latter that the accident took place; but the cause of the accident was not stated, although doubtless it was due to the misapplication of force in the violent stemming or forcing down of the cartridges, which being hard would tend to establish more friction.	1	—	X 47495
28	14 May	Gunpowder	Factory No. 2, Roslin. (Messrs. Hay, Merricks & Co., Limited).	One of the west ends of No. 2 Mill, exploded on a green charge. The mill had just started, and had performed about one revolution, when the charge exploded. No one was injured, and the mill was not damaged, beyond the roof being slightly shifted.	—	—	
29*	16 May	Guncotton -	Factory No. 9 Stowmarket. (The New Explosives Company, Limited).	Two of the acid centrifugal machines (Nos. 3 and 4) fumed off about 11 a.m. The fuming originated in No. 4, and extended to No. 3. The cause was believed to have been due to a drop of oil, as the machine had been oiled previous to the charge being put in. No one was injured, and no damage was done to machinery.	—	—	
30	9 May	Gunpowder	Bridge across the Pollochar Burn, near Grantown, Cromdale, Elgin.	A boy (13), after helping himself to some of the workmen's powder, set fire to it, and the resulting explosion slightly injured his face and hands. It appears that the workmen were in the habit of hiding their powder flasks in a rubbish heap, as they	—	1	X 47594

* *See* Annual Reports for 1886, pp. 32, 33, 53; 1887, p. 33; 1888, p. 36; for some observations on this class of accidents.

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	1894.						
			Bridge across the Pollochar Burn, near Grantown, Cromdale, Elgin —*cont.*	have had no proper place of storage at the quarries, and the lad seeing where they hid the powder, secured some of it after they had left. Steps have since been taken to stop the practice of keeping gunpowder in so careless and dangerous a manner.			
31	25 May	Gunpowder	Factory No. 26, Brecon. (Messrs. Curtis's and Harvey).	No. 5 Incorporating Mill exploded on a nearly full worked charge. No one was injured. The accident was due to the breaking of the screw holding the nut on the spindle, which allowed the nut to work off and fall on the mill bed.	—	—	
32	12 May	Gelignite -	Pen-yr-Orsedd Slate Quarry, Llandovery.	The deceased was fixing a fuze into a detonator (which latter was already in the cartridge), and it is supposed that he was either using too much force, or probably picking some dirt or foreign matter out of the detonator, when the explosion occurred, killing him instantly. It appears to have been the practice at the quarry to keep the cartridges in a tin, and the detonators separate in an old leather legging or gaiter in a dry hole in the corner of the shed, in which the workmen also kept their tools.	1	—	X 47691
33	24 May	Fireworks -	Small firework factory, No. 33, Gloucester. (Messrs. Penly & Son).	A rocket fired in a workman's hands during the operation of charging, but fortunately without causing any personal injury. The shed was slightly damaged.	—	—	X 47748
34	23 May	Gunpowder	Smithy at Kilkerran Railway Station.	A lad, aged 17, was carrying about 3 or 4 lbs. of gunpowder in a calico bag, from a licensed store to a stone blaster who was working at some little distance away. He went into a smithy on his way, left the bag on a bench and went out again. A spark from the anvil ignited the bag, and the explosion which followed severely injured a boy of 13, who happened to be waiting for some tools which were undergoing repair.	—	1	X 47795
35	30 May	Gelatine dynamite.	The Moelferna and Deeside Slate and Slab Quarries.	A "rockman" was ramming a hole charged with gelatine dynamite with an iron rammer when it exploded, injuring his left hand badly.	—	1	
36	4 June	Fire only (no explosive involved).	Factory No. 7, Kent (The Cotton Powder Co., Limited).	A workwoman carrying a bottle of methylated ether tripped over the hearth-rug and fell in front of the fire in the laboratory. The bottle was broken and the ether becoming ignited burnt her slightly and scorched the paintwork.	—	1	
37	15 June	Guncotton -	Factory No. 9, Suffolk. (The New Explosives Company, Limited.)	Two of the acid centrifugals fumed off in the morning. The cause was not ascertained, but it was probably due to a knot of grease in the cotton. No one was injured and no damage was done to machinery.	—	—	

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	1894.						
38	16 June	Signals for Life Saving Apparatus.	Nos. 8, 9, and 10, Hatton Garden, on premises occupied by James Hicks, scientific instrument maker.	The circumstances of the accident were of a somewhat peculiar character. About 2 o'clock on Saturday afternoon, at a time when the premises were closed, two explosions were heard, at an interval of about seven minutes between the two. These were found to have proceeded from two signal lights, which had with six others been suspended on the south wall of the house exposed to all weathers for about 2½ years. The The signals were of metal, cylindrical in shape and contained a charge of green fire, containing chlorate of barium and shellac, and in contact with the green fire was some quick-match (viz., strands of cotton impregnated with gunpowder). They were intended for use in conjunction with a kite in cases of shipwreck, and were fitted with electric wires for lighting them when over the ship by means of a battery on shore. The ignition or explosion was doubtless due to spontaneous decomposition, resulting from the contact of the sulphur in the gunpowder with the chlorate in the green fire composition, and the case bears a strong resemblance to that of the ignition of some green lances at Mr. Pain's factory in 1890,* which was clearly shown to have been due to the contact of a composition containing chlorate of barium with one containing sulphur. The only damage done on the present occasion was the breaking of a window and the displacement of a wire blind opposite, at a distance of about 42 feet.	—	—	
†39	24 June	Fire only (no explosive involved).	Factory No. 24, Cornwall. (East Cornwall Gunpowder Co., Limited.)	The fire took place in the charcoal store, and is believed to have been due to the spontaneous ignition of some charcoal. This store contained about 5 tons of stick charcoal and 7 tons of a partially ground charcoal called "flake charcoal," the grinding of which is completed in the factory where before such complete grinding it is usually stored in the unground charcoal store. The whole of this charcoal had been received in the week preceding the Sunday on which the fire occurred. It is thought that the case was one of spontaneous ignition, which may have been favoured by the charcoal being sent from the chemical works before it was properly cooled. Or conceivably (though the charcoal makers deny the possibility of this) there may have been some fire in the stick charcoal.	—	—	
40	29 June	Gunpowder	Factory No. 39, Kent. (Messrs. John Hall and Sons, Home Works, Faversham.)	An incorporating mill (one of a group numbered 133) exploded on a 60 lb. charge. The mill had only been started about five minutes and the charge was stated to have been properly liquored. No cause can be assigned. The damage done was inconsiderable.	—	—	

* Annual Report for 1890, p. 35, and Special Report, No. XCIV., 24th July 1890.

† It is rather noticeable that three fires have occurred in this house with *unground* charcoal, viz., this one, one in June 1893 (44/1893) and one several years ago (before the passing of the Act).

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	1894.						
41	20 June	Gelatine dynamite.	No. 3, Craigneuk Colliery, New Monkland.	Some workmen had charged three holes with gelatine dynamite, each charge being fitted with 3 ft. of safety fuze. Before they got clear one of the charges exploded, and the projected débris struck one of the men, injuring his hand. The other charges did not explode until they had got some 70 yards away. The cause of the "premature" was not ascertained.	—	1	X 48923
42	28 June	Detonator -	Wreck of S.S. "Dora," lying off Roker, Sunderland.	The operation of breaking up the wreck of the S.S. "Dora" was in course of being carried out with explosive, and for this purpose Ammonite was employed. A man placed the charge with fuze and detonator on board near the engine for the purpose of dispersing the wreck. He lit the fuze and was starting to run away when his foot caught in some iron-work. Seeing that the charge would explode before he could get his foot extricated, he pulled the fuze away with his hand. This prevented the cartridge from exploding but allowed the detonator to explode. The explosion of the detonator injured his face and one eye slightly.	—	1	
43	23 June	Gelignite -	Kelty Colliery, Fife	There were a number of men at work in the pit, and all but three of them had reached the surface before the accident occurred. The shots were being fired by electricity, and it appears that the current had been turned on while the three men were in the pit. These were injured.	—	3	X 48356
44	30 June	Gunpowder	Hothfield, Kent -	A youth (aged 18) purchased a pound of gunpowder in a canister. When he got home he tore the cover off, and seeing a little powder had leaked through the aperture in the top, he deliberately applied a lighted match, the resulting explosion severely injuring him and a companion who was with him. The case was one of sheer recklessness, as the powder appears to have been fairly secured.	—	2	
45	20 June	Blasting gelatine.	Monkland Colliery. -	Three shot holes had been drilled, one near the centre of the mine, and one at each side. The left hole was charged with two cartridges of blasting gelatine, the centre one with four cartridges, and the one on the right with three cartridges, the stemming used in each case being ground fire-clay. "Red-cord" fuze was used, those for the side shots being cut to a length of about 2 ft. 6 ins., and that for the centre shot being cut to a length of 3 feet, the latter being from a new hank of fuze. The left shot and the centre shot were lighted simultaneously, and whilst the one on the right was being lighted, the centre shot exploded, injuring one man severely. Another man had a narrow	1	—	X 48368

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	1894.		Monkland Colliery —*cont.*	escape. It was estimated that between the lighting of the centre shot and the explosion of the charge, not more than five seconds elapsed. The accident was, no doubt, due to the defective fuze. (A piece about 3 feet long, on being tested, burnt in about 20 seconds).			
46	6 July	Detonators	Near Tanygrisiau -	The deceased was fatally injured by the explosion of some detonators in his pocket, into which he inadvertently put his lighted pipe. He and several others were celebrating the wedding of a local tradesman, by firing off gelatine cartridges, when the accident occurred. The coroner's jury returned a verdict of accidental death.	1	—	
47	13 July	Detonator -	Factory No. 65, Kent. (The Henry Rifled Barrel, Engineering, and Small Arms Co., Limited.)	A fuze cap or detonator fired in a 4·7 in. fuze pellet, while being fixed in the pellet, in No. 12 shed. The man who was in the shed at the time was slightly injured, but no further damage was done.	—	1	
48	4 July	Guncotton -	Oakeley Slate Quarries.	Whilst re-drilling a hole an explosion occurred, causing slight injury to the miner at work. The man was under the impression that he had chiselled off the whole of the stump hole at the time he recommenced drilling.	—	1	
49	19 July	Tonite or Cotton Powder.	In the Solent, during removal of the "Azalea" (a wreck) by blasting.	A charge which missed fire was recovered and placed in a boat. While there it exploded, killing all the men engaged in the removal of the wreck. The explosion was doubtless caused by one of the men trying to extract the detonator from the recovered charge. (*Inquiry and Special Report No. CVIII.*)	7	—	X 48534
50	19 July	Gunpowder	Factory No. 39, Kent. (Messrs. John Hall and Sons.)	Four incorporating mills, Nos. 112 and 113 which had been running for about 1½ hours on 60 lb. charges exploded. The charges were properly liquored at starting. The millman was burned about the head and hands, and a youth who was passing along the private road, outside the mills, was slightly injured. The boards of the mills were entirely dislodged, and some small damage was done to the adjoining cottages in the shape of broken glass and displaced slates. The drenching apparatus seems to have acted properly, but was not in time to protect the two pairs of mills, No.112, separated by a brick traverse, from the flash of No. 113, where it is supposed the first explosion took place.	—	2	
51	20 July	Detonators	Factory No. 18, Stirling. (Nobel's Explosives Co., Limited.)	Explosion of detonators during pressing. Punches, soleplate and guides destroyed and three panes of glass were broken. No one was injured; the cause of the accident was not ascertained.	—	—	

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	1894.						
52	20 July	Guncotton and gunpowder.	Oakeley Slate Quarries.	A miner had fired a shot of guncotton and gunpowder, and it appears that a remnant of the guncotton exploded, and slightly injured him in the face. Probably some fire had continued to linger in the hole, in part of the fuze or other combustible material.	--	1	
53	6 July	Roburite -	Wirral Colliery, Cheshire.	A shot had missed fire, and in order to get out the charge the miner attempted to remove the coal containing it with his pick, the blade of which he inserted under the roof. It slipped and struck the charge, which exploded, injuring him slightly.	—	1	X 48712
54	25 July	Guncotton and gunpowder.	Oakeley slate quarries	A miner who was working at 75 yards distance from the blasting operations, thinking himself safe, failed to retire under cover. He was severely wounded in the neck by a piece of stone.	—	1	
55	3 Aug.	Gelatine dynamite.	Minera mine, Wrexham.	Two men were using a rock drill, and bored into an old hole containing an unexploded cartridge of gelatine dynamite. One man who was about 7 feet off was cut about the cheek, and his eyes were injured. The other, who was at the drill-handle, was unhurt.	—	1	
56	18 Aug.	Detonator -	St. Helen's, Lancashire.	A boy found a detonator in a field. and struck it with a hammer. His right eye and left hand were seriously injured.	—	1	
57	13 Aug.	Detonator -	Burnbank, Hamilton, N.B.	A boy aged 15 found a detonator in the refuse heap of a mine, and subsequently attempted to pick out the contents with a pin. It exploded, and injured both his hands and his face.	—	1	X 49093
58	16 Aug.	Guncotton and gunpowder.	Oakeley quarries -	A quarryman had charged two holes with a cartridge of guncotton and a charge of gunpowder in each. He fired one of the holes, and on returning three or four minutes afterwards the second exploded. No doubt the fuze had been ignited by the first shot. One of his eyes were injured.	—	1	
59	13 Aug.	Gunpowder	Lovington Street, Leeds.	A boy, aged 13, bought 3 ozs. of gunpowder and ignited it in the street. He was slightly injured.	—	1	
60	28 Aug.	Fireworks (coloured stars).	Factory No. 158, Gloucester. (Mr. Isaac Crane.)	About 6 lbs. of yellow stars had been drying on a zinc tray over a vessel containing hot water for about half an hour, when they ignited, slightly damaging the building, and setting on fire 4 or 5 lbs. of red fire composition also drying on paper in the building. The yellow stars contained oxalate, chlorate, and nitrates of sodium, barium, and potassium, and it is supposed that the oxalate of sodium in the presence of a nitrate may have given rise to decomposition.	—	—	

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	1894.						
61	4 Sept.	Gelignite -	Factory No. 141, Cornwall. (National Explosives Co., Limited.)	An explosion took place in the mixing-house of the factory, the two men working in it being killed. The cause was not ascertained, but was probably some foreign substance in the machine. (*Inquiry and Special Report No. CIX.*)	2	—	
62	28 July	Detonator -	Ballygrant, Island of Islay.	Some boys found a box of old detonators in a quarry where they had probably been hidden or lost by workmen several years ago. One of them began to pick out the detonating composition with a pin; the explosion which followed blew off three of his fingers. Incidentally the inquiries made by the local authority elicited the fact that a considerable store containing explosive in the Island had been for two years without a license. Proceedings were instituted against the owner and occupier. These proceedings, however, were abandoned, owing to the decease of the resident factor of the Island.	—	1	X 48398
63	11 Sept.	Fire only (no explosive involved).	Factory No. 36, Hants. (Schultze Gunpowder Co., Limited.)	A fire broke out in the disintegrating room of Building B. In this room the wood fibre was torn down by disintegrators, and there was a considerable quantity lying loose, ready for transference to the drying trays. Some of the lighter portions had floated up, and rested upon the bearings supporting the shaft which carries the driving pullies to the disintegrators. One of the bearings apparently heated and ignited the loose wood fibre adjacent; this communicated with the mass and burnt fiercely. No one was injured, and the structural damage to the corrugated iron building was very little.	—	—	
64	16 Sept.	Detonator -	Ton Fawr, near Ruthin.	A boy found a detonator, took it home and began picking out the contents with a hairpin, when an explosion occurred, shattering both his hands. His sister, who stood near him, was severely injured, and a number of glass articles in the house were broken.	—	2	
65	19 Sept.	Small arm cartridges for elephant shooting.	98, New Bond Street. (Messrs. Holland and Holland.) Registered premises, No. 2406.	The ammunition which caused the accident was intended for 8-bore rifles for elephant shooting, the cartridges being of an exceptional character, weighing about 10 drams, contained a charge of gunpowder of nearly $\frac{3}{4}$ oz., and a lead bullet faced with steel front. The ammunition was manufactured at Kensal Green, and was brought to Bond Street to be packed for exportation; this work was being carried on at Bond Street, and whilst one of the cases was being lifted on to a wooden bench by a boy (aged 15) he let it fall, and out of 100 cartridges it was found that nine had exploded. The cartridges were packed lengthways, so that the	—	1	

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	1894.						
			98, New Bond Street. (Messrs. Holland and Holland.) Registered premises No. 2406—*cont.*	bullet of one pressed against the cap of another ; when the box fell it was supposed that the concussion forced them together and caused the explosion.			
66	19 Jan.	Not known	39, Cemetery Road, Barnsley.	The servant was raking some coals from the back of the fire when she noticed a strange light and heard a noise. An explosion immediately followed, fortunately without causing any personal injury. The bottom and side of the grate were blown out, and smashed to pieces, and the window was blown out to a considerable distance. It was supposed that the coal had come from a pit where explosives are used.	—	—	
67	18 Sept.	Gelatine dynamite.	Mawddach Copper Mine.	Two shots had to be fired in two large stones which had already been broken from the face of the cliff in working. One of the shots went off, and the other hung fire. On the man returning towards the shot it went off, injuring him.	—	1	
68	4 Oct.	Ballistite -	Factory No. 3, Ayr. (Nobel's Explosives Co., Limited.)	The chemist was sealing a sample of ballistite (consisting of a few grammes) in a glass tube, by the melting of the glass with a Bunsen burner (the tube having previous to filling been drawn out to a small diameter) when it exploded, inflicting a few scratches about his face and hands.	—	1	
69	16 Sept.	Detonators	Hampstead, Staffordshire.	Several children (of ages varying from five to nine) whilst playing in a brickyard discovered a barrel containing gunpowder, and a quantity of detonators. After helping themselves, they began to play with the explosives, the result being that one of them had his left hand blown off, while two others were slightly injured about the face. Proceedings were instituted by the local authorities against the occupier of the brickyard for unlawful possession of explosive, and he was convicted and fined 10*l.* and 12*s.* 6*d.* costs. The explosive was declared forfeited.	—	3	
70	4 Oct.	Fireworks -	Factory No. 158, Gloucester. (Mr. Isaac Crane.)	During the process of charging a 1 oz. rocket (a brass charging rod being used) an explosion occurred. The flame communicated to all the composition in the building, viz., about 13 lbs., together with 1 lb. of bright stars, two dozen 1 oz. filled rockets, one 1 lb. rocket, and four ¼ lb. rockets. No one was injured. The cause of the accident was not ascertained. The composition had been carefully sifted.	—	—	
71	1 Oct.	Gunpowder	North Biddick Colliery, Washington, Durham.	A new shaft was being sunk, and two sinkers were ascending the shaft with a small quantity of gunpowder in a box, when a spark from a candle they had fell into the box and caused the explosion. The men were burnt about the arms, but not seriously.	—	2	

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72	1894. 25 Sept.	Dynamite -	Near the tunnel of the North British Railway, near Edinburgh.	Deceased was one of several persons engaged in blasting operations. Two holes had been charged, and deceased had lit the fuze attached to one of them, when the fuze he had in his hand went out. Without waiting to relight it he called to the others to run to a place of safety. In doing so it appears that a lamp carried by one of the men accidentally lit the fuze of the other cartridge. Deceased not being aware of this went back, when the shot went off and he was fatally injured.	1	—	X 49790
73	9 Oct.	Schultze gunpowder and gunpowder.	13, Blackwellgate, Darlington. Registered premises, No. 2407. (J. F. Smythe, Gunmaker).	The explosion originated in the filling room in which a boy was present, the nitro-powder which fired communicating to the gunpowder in a safe, the door of which was ajar. The most probable cause being either the ignition of some Schultze gunpowder, spilt on the floor, by treading on it with ordinary boots, or some boyish experiment of the deceased. (*Inquiry and Special Report No. CX.*)	1	10	
74	3 July	Gunpowder	Former Lane, Sparkhill, Worcester.	A number of boys broke into Messrs. Ludlow & Co.'s Fog Signal Factory, at Former Lane, Sparkhill, and having obtained some gunpowder they made a hole in the field, placed the gunpowder in it, and one of them put a lighted match to it, when it exploded, burning him very badly about the face and hands.	—	1	
75	19 Oct.	Detonators -	Factory No. 18, Stirling. (Nobel's Explosives Co., Limited.)	Explosion of some detonating composition under one of the standards of the charging machine. The nut on the underside of one of the standards had become loose and so allowed some powder dust to get between it and a washer. When the charging plate is agitated, to cause the powder to fall into the tubes, this nut and washer would strike each other, and fire the loose powder between them. On this occasion no damage was done to the machinery; the wood under the standard was cracked for a few inches. Steps have now been taken to fasten the nuts in such a way as to prevent them getting loose.	—	—	
76	18 Oct.	Dynamite -	Huntershill Quarry, Bishopbriggs.	Two holes had been bored and charged, the quarryman in charge superintended the work; after ordering the men to retire he ignited the fuzes, which were each timed to burn about 2½ minutes. After a lapse of about 2½ minutes one shot was heard to go off, followed in about the same time by the other. On the men returning they found their overman seriously injured. It was supposed that after he had lighted the first fuze, he had experienced some difficulty in igniting the other, and had only succeeded when the first shot went off. He was a man of considerable experience and always fired the shots himself.	—	1	X 49945

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					Killed.	Injured.	
77	1894. 22 Oct.	Fireworks -	Factory No. 76, Surrey. (Messrs. C. T. Brock & Co.)	A man was engaged in charging fireworks of the description known as "Jewel Fountains," when he heard a crack and observed smoke issuing from the case which he was driving. He promptly, and with considerable presence of mind, threw the case and the nipple on which the case was being charged and the drift out of the window, thus avoiding any injury either to himself or the shed. The accident is believed to have resulted from the charger having put in an unduly small amount of what is technically known as "first fire" composition, thus enabling the end of the drift (which was split) to come into contact with the flat top of the gun-metal nipple, and it was believed that one of the pieces of coloured stars which are inserted in these fireworks had come between the drift and the nipple and caused the ignition. Steps have been taken to render such an occurrence less probable in future.	—	—	
78	20 Oct.	Nitro-glycerine.	Factory No. 3, Ayr. (Nobel's Explosives Co., Limited.)	Two men were engaged in emptying a barrel which had been used for washing the muddy "rests" from the nitro-glycerine manufacture and from the saltpetres, and on tilting it up, the barrel slipped on the block and a slight explosion followed, due, it is supposed, to the adherence of a small drop or smear of nitro-glycerine on the outside of the barrel, probably assisted by grit. No damage or personal injury occurred. Steps have been taken to prevent a recurrence by covering the wooden block against which the tub is tilted with a sackcloth pad and careful wiping of the tub. The accident is interesting as illustrating the extreme sensitiveness of nitro-glycerine to a glancing blow under certain conditions.	—	—	
79	19 Oct.	Blasting gelatine.	Dolgelly. (Mine of the British Gold Fields, Limited.)	Two holes were charged with blasting gelatine and fired, and two reports were heard. One of the charges, however, did not do its work, and it was whilst deepening the hole by means of a drill and hammer that the explosion occurred; doubtless a portion of the charge remained unexploded in the hole. The two miners engaged were slightly injured.	—	2	
80	24 Oct.	Gunpowder	Threlkeld Granite Company's Works, Keswick.	The fireman was charging a small hole (8 ins. deep) with gunpowder. He had almost completed the charge when it exploded and injured his hand and one of his eyes. He afterwards confessed that he was using an iron rammer, contrary to the rules of the quarry.	—	1	

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons		Home Office Registry No.
					Killed.	Injured.	
81	1894. 18 Oct.	Detonator -	Parkhead, Edinburgh.	A youth (aged 16) had surreptitiously obtained two detonators from a box at the extension works of the Central Railway between Bridgeton and Carmyle. The lad was employed as a "nipper" by the contractors, and had been warned not to interfere with the detonators. The explosion was caused by his applying a lighted match to the detonator. He lost the thumb and some fingers of his left hand. Further steps have now been taken to prevent the detonators being abstracted from the box where they are kept.	—	1	X 49955
82	30 Oct.	Gunpowder	Factory No. 37, Kent. (Messrs. John Hall & Son.)	Two pairs of incorporating mills (numbered 42 on the plan) exploded after running for about 40 minutes on 60 lbs. charges. The charges had been liquored at starting. No one was injured, and the windows of the mill were unbroken.	—	—	
83	5 Nov.	Fireworks -	Shop at Thirsk. Registered premises No. 2,410.	The shop was registered for mixed explosives, and at the time of the explosion contained about 25 lbs. of fireworks, which were kept on shelves in a glass cupboard, immediately behind the counter. The occupier took a cracker out of the cupboard (leaving the door open), and lighting it at the gas over the counter, threw it to the doorway, and doubtless some sparks flew into the cupboard and ignited the other fireworks. He had his hands slightly burnt in extinguishing the fire. The damage done to stock and building was estimated at about 85*l*.	—	1	
84	7 Nov.	Fireworks - (Socket alarm signals).	Factory No. 153, Edinburgh. (Thos. Hammond).	It appears that a new description of maroon or shell signals for use on board the London boats was being manufactured for experiment. The signal, $4\frac{3}{4}$ ins. long and $1\frac{1}{4}$ ins. diameter, consisted of a brown paper case, closed at top and bottom with wood. The charge was $1\frac{1}{2}$ oz. of powder, but on this occasion they were being charged with chlorate of potash and orpiment, contrary to the instructions of the occupier. Eight signals had been completed, and on attaching the wooden top to the ninth the explosion occurred, lacerating the hand of the workman (the occupier's son, aged 21), necessitating its amputation. The damage to the shed was very slight, and consisted of a broken window.	—	1	
85	5 Nov.	Gunpowder	Flatt's Farm, Bishop Auckland.	In celebrating Guy Fawkes day, a youth (aged 19) was seriously injured by the bursting of a piece of metal gas piping (about 1 in. in diameter) charged with gunpowder, which he imprudently ignited. He subsequently succumbed to his injuries.	1	—	X 50228

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons		Home Office Registry No.
					Killed.	Injured.	
	1894.						
86	9 Nov.	Fog signals	Factory No. 107, Worcester. (Messrs. T. Jenkins & Co.)	Two fog signals were placed in the die together. The explosion which followed slightly injured one of the workpersons. Steps are being taken by the manufacturers to provide screens of a character likely to more effectually protect the workperson in the event of a similar accident occurring.	—	1	
87	9 Nov.	Gunpowder	Bishop Auckland, Durham.	Some boys obtained 1 lb. of gunpowder, and one of them put some of it into his jacket pocket; they also had matches. One of them struck a match, and it was supposed that a spark therefrom ignited the powder in the boy's pocket. He was badly burned by the explosion.	—	1	
88	5 Nov.	Socket sound signal.	131, Park Hill Road, Cockburn Street, Liverpool.	A socket sound signal was discharged from the roof of a house, an old tin canister being used in place of a socket. The rocket ascended only a short distance and fell in the street, where it exploded throwing up a quantity of loose gravel from the centre of the street, damaging the front windows of several houses, and injuring four children who were standing in the street at the time. Proceedings were instituted against the person who fired the rocket, and he was convicted and fined 2*l.* and 4*s.* 6*d.* costs.	—	4	
89	2 Nov.	Gunpowder	Spennymoor - -	An explosion occurred in the pantry of a dwelling-house occupied by a coal miner, Spennymoor, Durham. The occupier states that there were 10 lbs. of gunpowder in the room, and that he had been there with a lighted lamp a few minutes before, but that at the moment of the explosion no one was in the house. He could not account for the accident, but admitted that he had made blasting cartridges the day before, for which offence he was convicted and fined 1*l.*	—	—	
90	17 Nov.	Detonator -	Factory No. 150, Gloucester. (Mr. Frank Brain.)	Whilst a workman was engaged in hammering down a nail, which protruded from the table he was working at, a few rejected detonator shells (which were supposed to be empty and which had been resting on a window ledge above it) fell down and the blow from the hammer descending upon one of them caused an explosion, which slightly injured him. Evidently the detonator shell contained a remnant of fulminate. Steps have been taken to prevent a repetition of such an accident.	—	1	
91	23 Nov.	Gelignite -	Fernaig, on the Kyleakin Railway, in course of construction.	The deceased was engaged in charging a hole in the rock with a wooden rammer when an explosion occurred and it was blown through his body killing him instantaneously. Three men standing by were also injured.	1	3	X 50609

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons Killed.	No. of Persons Injured.	Home Office Registry No.
	1894.						
92	30 Nov.	Gunpowder	Factory No. 33, Westmoreland. (New Sedgwick Gunpowder Co.)	An incorporating mill (No. 9) exploded after running about ten minutes on a green charge of 65 lbs. Nothing was displaced except the tarpaulin covering sheet, and no one was injured. The cause of the accident was not ascertained.	—	—	
93	12 Dec.	Gunpowder	Factory No. 143, Edinburgh. (Midlothian Gunpowder Co., Limited.)	Incorporating mill, No. 2 (one of the mills marked No. 7 on plan attached to the factory license) exploded immediately after starting on a green charge. No one was injured. The outside plough was split in two, and one of the runners had gone over a part of it, but whether this happened before or was caused by the explosion was not ascertained. The damage was confined to the blowing off of the roof, and the blowing out of the woodwork of the side walls. The débris in the mill bed was minutely examined, but without discovering the cause of the accident.	—	—	X 22253/27
94	28 Nov.	Gunpowder	Treherbert, Glamorgan.	Several boys were playing with gunpowder, which they purchased at an ironmonger's shop, and one of them was severely burnt by the explosion which followed. The boy who purchased the powder was stated to have been only 12 years of age, and proceedings were instituted against the vendor of the explosives for selling explosives to a child *under* 13 years of age. Witnesses, however, came forward and proved that the boy was 13 years of age at the time, and the summons was dismissed. (*See* Appendix T (*b*).)	—	1	
95	10 Dec.	Detonator	Blaenclydach, Glamorgan.	A boy aged seven had two forefingers, thumb, and portion of his left hand blown off, a punctured wound in right hand, also wound in centre of forehead, and right eye blown out by a detonator. The boy's statement that some other boys had asked him to hold the detonator, and that one of them set fire to it with a match, was contradicted by two men who were in their gardens adjoining the lane (divided by a high wall), who hastened to the spot on hearing the explosion, and who asserted that had there been other boys near they must have seen them. The lad's father had, it appears, received some detonators which he kept in a cup in his bedroom, from whence the lad obtained them.	—	1	
96*	13 Dec.	Gelatine dynamite.	Virtuewell Colliery, Benhar.	Two holes were charged and the fuze of one lighted. After it exploded, one of the men returned to light the second fuze, and on approaching it, the charge went off, the fuze having probably been ignited by the discharge of the first. He was badly injured.	—	1	X 50955

* *See* Accident 58 for a similar result.

Index No.	Date of Accident.	Nature of Explosive.	Where Accident occurred.	Cause of Accident so far as ascertained.	No. of Persons		Home Office Registry No.
					Killed.	Injured.	
97	1894. 24 Dec.	Blasting gelatine.	Elderslie Quarry, near Paisley.	A quarryman was forcing home a cartridge which had stuck, using a wooden pole 6 ft. long, and about 1½ ins. diameter, when an explosion occurred, fatally injuring him, the rod being blown through his breast, and projecting over 3 ft. from the back. The end had to be sawn off by the doctor before he could be removed to the hospital.	1	—	X 50989
98	31 Dec.	Gelignite -	New East and West Railway Works, Derby.	A workman was charging a newly bored hole in the rock, and had inserted six cartridges, four *soft* and *two* hard ones, and while he was in the act of ramming the hard ones into the hole with a wooden rammer, the explosion occurred. He stated that he saw a spark in the hole, but was unable to get away in time. He was badly injured.	—	1	
99*	24 Apr.	Detonator -	Ryhope Colliery, near Sunderland.	A man had an eye and hand injured by the explosion of a detonator from some unexplained cause.	—	1	
100*	30 June	Carbonite -	Trimdon Grange Colliery, Trimdon Grange.	A man whilst firing a shot of Carbonite by means of an electric exploder was seriously injured in the leg by a stone which rebounded around a curve.	—	1	
101*	26 July	Carbonite -	East Hetton Colliery, near Coxhoe, R.S.O.	A man was injured in the face and eyes by the charge exploding whilst he was engaged in stemming it with a wood beater. The charge contained a detonator.	—	1	
102	31 Dec.	Detonator -	Moorgate Street, Sunderland.	Several boys obtained some detonators from a room wherein a small quantity of explosives had been placed for safety, and supposing them to be a description of firework, they proceeded to ignite one of them with a match. The explosion which followed injured three of the boys (one had several fingers blown off, another had to have an eye removed, while the third boy was slightly injured).	—	3	

* These three accidents only came to the notice of the Department in January 1895.

APPENDIX X.

Accidents in Thawing Dynamite.

United Kingdom.

No.	Date.	Place.	No. of Killed.	No. of Injured.	Total No. of Casualties.	Remarks.
1	Winter of 1871-72	Wheal Agar Mine, near Pool, Cornwall.	—	—	—	Some cartridges which were being thawed in the dry house of the mine round the stove exploded and blew the roof off.
2	9 Oct. 1872 -	Chwarel Fawr Quarry, near Carnarvon.	2	—	2	The deceased were thawing dynamite on a stove in the weigh house.
3	9 Dec. 1872 -	Cottage at Luxulion, Cornwall.	1	6	7	Thawing dynamite in front of a kitchen fire.
4	10 Dec. 1872 -	Fowey, Cornwall -	—	1	1	Similar accident.
5	10 June 1873 -	Frizington, Whitehaven.	—	—	—	A man put a packet of dynamite into a cottage oven to thaw it. House wrecked. No one in the room at the time.
6	10 Feb. 1874 -	Airesland, Wigtown -	—	1	1	The injured man was thawing dynamite on a shovel.
7	— Aug. 1873 -	Airyhemming -	—	2	2	Similar accident.
8	12 Feb. 1875 -	Eston, Cleveland -	2		2	Dynamite placed near fire to thaw.
9	23 Feb. 1875 -	Mountain Ash -	1	2	3	Dynamite placed in oven to thaw.
10	— — 1874 -	Avonmouth, Bristol -	—	—	—	Dynamite thawed in a chest by steam not under pressure exploded. This is a curious instance of explosion by exposure to heat not exceeding 212° F., and was probably, result of decomposition in the first instance.
11	17 Nov. 1875 -	Llanbedrog Quarry, Pwllheli.	1	3	4	Thawing dynamite on a shovel.
12	1 May 1876 -	Morrisonshaven, Prestonpans.	1	2	3	Man put a "warmer" containing dynamite on a smithy fire and blew the bellows. The warmer was a canister in a kettle of water.
13	26 Nov. 1877 -	Minera Mine, Wrexham.	—	1	1	Man thawing dynamite at a candle. Left hand shattered.
14	24 Jan. 1878 -	Caermincian Quarry, Llanberis.	2	—	2	Thawing dynamite by a fire. One of the men was blowing a bellows at the time.
15	23 Jan. 1878 -	Dinorwic Quarries, Llanberis.	—	1	1	Man warming three primers of dynamite on a stove.
16	4 Dec. 1878 -	Letterwood, Oban -	2	—	2	Thawing dynamite in water (or in a tin in water) over a fire.
17	21 Dec. 1878 -	Talargoch Mine, Rhyl	1	1	2	Heating dynamite in a tin over a candle.
18	9 Jan. 1879 -	Halkyn, Flint -	—	—	—	Dynamite exploded while being thawed in a manure heap heated by a steam-pipe. Compare No. 10.
19	29 Jan. 1879 -	Newcastle-on-Tyne -	—	3	3	A small vessel inside a metal bucket was being used for thawing dynamite. An explosion took place when the water was heated on a fire, probably through accidental presence of dynamite in the water.
20	29 Jan. 1879 -	Festiniog -	—	2	2	Thawing dynamite before a cottage fire.
21	13 Feb. 1879 -	Lochcarron - -	1	—		Man killed in re-heating some water used for thawing dynamite, with which it must have come into contact. Compare No. 19.
22	21 March 1879 -	Low Hale Colliery, Wigan.	—	3	3	Men thawed dynamite in water and threw the water under the grate. The water which contained nitro-glycerine naturally exploded, and the explosion was communicated to other cartridges on the floor. Compare Nos. 19 and 21.
23	14 April 1879 -	Praze, Cornwall -	2	—	2	Thawing dynamite before a fire.
24	19 June 1880 -	Glencruitten, Oban -	—	2	2	Similar to 19. The inner can had a hole in it.
25	4 March 1880 -	Craig, Montrose -	5	1	6	Explosion of a kettle containing water from a warming pan, in the inner casing of which there was a hole. Compare Nos. 19, 21, 22, 24.
26	5 Apr. 1880 -	Hawkesbury Colliery, Bedworth.	1	—	1	Re-heating water in which dynamite had been thawed. Compare Nos. 19, 21, 22, 24, 25.
27	1 Dec. 1880 -	Great Pant-y-Pydew Mine.	—	2	2	Dynamite put on a hob to thaw.
		Carried forward -	22	33	55	

No.	Date.	Place.	No. of Killed.	No. of Injured.	Total No. of Casualties.	Remarks.
		Brought forward -	22	33	55	
28	18 Jan. 1881 -	Berehaven Mines -	2	3	5	Dynamite put on a hot iron tube to thaw.
29	15 Feb. 1881 -	Beath, near Kelty -	—	1	1	Man rubbing two cartridges of dynamite together in his hands to complete thawing.
30	1 May 1882 -	United Phœnix Mines, Cornwall.	—	1	1	Thawing dynamite over a candle.
31	26 Jan. 1883 -	Glascoed, Llanbaddock.	—	3	3	Man put dynamite into an oven to thaw.
32	2 March 1883 -	Tunnel, near Bangor -	1	—	1	Thawing dynamite near a fire.
33	29 March 1883 -	Southrigg Colliery, Airdrie.	1	1	2	Dynamite placed to thaw in extemporised warming pan in hot ashes. Probable leak in inner tin or no water between inner and outer tins. Compare Nos. 19, 21, 22, 24, 25, 26.
34	2 April 1883 -	South Phoenix Mine, Cornwall.	—	3	3	Thawing dynamite near a hot iron tube. Compare No. 28.
35	8 Nov. 1883 -	Plumbley Colliery, Eckington.	1	1	2	Dynamite placed under a fire on a pit bank to thaw it.
36	7 Nov. 1883 -	Rhondda Merthyr Colliery, South Wales.	—	2	2	Thawing dynamite near fire.
37	7 Nov. 1883 -	Greengairs, Airdrie -	2	2	4	Dynamite placed on a hob to thaw.
38	17 Dec. 1883 -	Cardenden Colliery, Fifeshire.	—	1	1	Thawing dynamite on a piece of tin over a lamp.
39	17 Dec. 1883 -	Town Hill Colliery, Dunfermline.	1	1	2	Similar accident.
40	3 Nov. 1883 -	Pumpherston Oil Works, Mid Calder.	—	1	1	Thawing dynamite in his hand before a fire.
41	18 Dec. 1884 -	Holywell, Flint -	—	2	2	Thawing dynamite in a tin before a fire.
42	2 Jan. 1885 -	Carrickfergus -	1	—	1	Man holding dynamite to thaw before a fire.
43	1 April 1885 -	New Inn, Rhondda Valley.	2	1	3	A man put dynamite to thaw in a saucepan and then into an oven.
44	31 March 1885 -	Halifax - -	1	1	2	Man thawing dynamite before a boiler fire or picking at it when hot.
45	8 Jan. 1886 -	Camps Lime Works, Kirknewton.	—	3	3	Thawing dynamite in a tin before a fire.
46	12 Jan. 1886 -	Mancetter Bridge (Oldbury) Quarry, Atherstone.	1	—	1	Thawing dynamite in a tin over a fire.
47	20 Jan. 1886 -	Railway in course of construction near Clonakilty, co. Cork.	1	—	1	Blasting gelatine placed in a tin kettle near a fire and either a boy (killed) meddled with it or it became overheated.
48	19 March 1886 -	Butterton, near Leek -	1	1	2	Gelatine dynamite put in an oven to thaw.
49	9 April 1886 -	Craven Moor Lead Mine, Pateley Bridge, Leeds.	1	—	1	Thawing dynamite over a candle.
50	8 Nov. 1886 -	Raisby Hill Quarries, Durham.	—	1	1	Thawing dynamite in front of a fire.
51	8 Jan. 1887 -	Railway in course of construction at Ballintubber, co. Wexford.	3	—	3	Man placed can containing dynamite and water on fire.
52	12 Jan. 1887 -	Railway in course of construction at Ballintubber, co. Wexford.	—	—	—	Man placed can containing dynamite and water on fire.
53	13 Jan. 1887 -	E. Romans Mine, Shropshire.	—	3	3	Man placed can containing dynamite and water on fire.
54	27 April 1887 -	Quarry at Worrall, near Bradfield.	—	5	5	Thawing dynamite on hot shale close to a fire.
55	12 Nov. 1887 -	Barry Railway, near Cardiff.	1	—	1	Thawing dynamite in a metal can over a fire.
56	16 Jan. 1888 -	Ratcleugh Quarry, near Alnwick.	1	—	1	Carrying dynamite in a bucket of hot ashes.
57	29 Feb. 1888 -	Bolts Burn, Rookhope, Durham.	1	—	1	A cartridge of gelatine dynamite left in pocket of trousers which were hung to dry before the fire.
58	16 March 1888 -	Melyn Tin Works, Neath.	1	—	1	Kneading dynamite placed to thaw on hot cinders.
59	17 Dec. 1888 -	Pencoed, Llanelly -	2	1	3	Thawing dynamite in a bucket over a fire.
60	13 Feb. 1889 -	Pentrebach, Old Iron Works, near Merthyr.	1	—	1	Thawing dynamite in a metal can on or near hot cinders.
61	23 Feb. 1889 -	Cwm Mawr Mine, Merioneth.	—	1	1	Boiling dynamite with water in a can over a fire.
62	5 Feb. 1890 -	Burradon - -	—	4	4	Thawing dynamite in a can of water placed in an oven.
63	18 Feb. 1890 -	Colwill Quarry, near Egg Buckland, co. Devon.	2	—	2	Thawing dynamite by steaming it in an old straw hat placed over hot water containing nitro-glycerine.
		Carried forward -	50	76	126	

No.	Date.	Place.	No. of Killed.	No. of Injured.	Total No. of Casualties.	Remarks.
		Brought forward -	50	76	126	
64	— March 1890 -	Moss Bay Iron Company's Works, Maryport.	1	1	2	A man put about 5 lbs. of dynamite on stove and 60 more cartridges before fire. He was under the influence of drink at the time.
65	4 July 1890 -	Bonnyside Fireclay Mine, Bonnybridge, Stirlingshire.	—	1	1	A man was engaged in heating water for thawing dynamite, which had previously been used for that purpose, when an explosion took place.
66	26 Nov. 1890 -	Radyr Quarry, Llandaff.	2	1	3	A man thawed dynamite in a bucket of water, and then put the dynamite into a proper warming pan and filled up the outer case of the pan with water from the bucket. Some time afterwards another man, in ignorance of what had been done, put the water from the outer casing of warming pan into a bucket and placed it on the fire to heat. An explosion immediately took place.
67	9 Jan. 1891 -	Creagmore House, Kilmakie, Inverness-shire.	2	2	4	Some blasting gelatine cartridges were put into a canister which was placed into a kettle on kitchen fire.
68	19 Dec. 1891 -	Navigation Sinking Pits, near Pontypridd, Glamorganshire.	—	2	2	Some water, which had previously been used for thawing dynamite, was put into a tea kettle. The water is supposed to have contained nitro-glycerine. There is said to have been a leak in the warming pan.
69	16 Jan. 1892 -	18½, Bute Town, Ponttottyn, Merthyr Tydvil.	—	1	1	Two dynamite cartridges placed in an oven.
70	27 Feb. 1892 -	Penrhiewfer Colliery, near Dinas.	3	—	3	Thawing dynamite in a tin over a paraffin lamp.
71	23 Feb. 1893 -	Machine House of Mr. Lewis Thomas, Wern Colliery, Pontypridd.	—	2	2	Some dynamite cartridges placed on shovel over the fire to thaw them.
72	6 Nov. 1893 -	Scot Hay, near Silverdale.	2	1	3	Tin canister of gelatine dynamite placed in oven boiler to thaw.
73	3 March 1894 -	Llest Colliery, Pontyrhill.	1	2	3	Tin containing some water that had been previously used for thawing, exploded on being placed on the fire.
74	14 March 1894 -	Llanberis Slate Quarries, Dinorwic.	1	—	1	Thawing gelatine dynamite; the man, who was alone, was killed. He was using an improvised apparatus before or over a fire, notwithstanding printed instructions warning against the practice.
		Total - - -	62	89	151	Each "accident," therefore, on an average, killed or wounded more than two persons.

APPENDIX Y.

EXPERIMENTS to ascertain the effect of the Explosion of Gunpowder on Magazine Clothing, carried out at ROYAL ARSENAL, WOOLWICH, on 27th February 1894.

Description.

Five dummies placed in a temporary building at Outer Marsh.

Figure "A."—Dressed in a suit that had been used for filling shell with picric acid.

Figure "B."—Dressed in a suit that had been in use about six months in the filling of cannon cartridges.

Figure "C."—Dressed in a suit that had been in use for about nine months in the operations of filling percussion caps with detonating composition.

Figure "D."—Dressed in a new suit.

Figure "E."—Dressed in a suit that had been in use for about three months in mixing detonating composition.

100 lbs. of P. and F.G. powder mixed, was placed loosely on the floor of the building; also one muslin bag containing 1½ lbs. of L.G. was placed about level with the thighs of each dummy.

The powder on the floor was ignited by a No. 10 tube electric, with quickmatch attached.

Result.

The roof of the building was blown off. The dummies were not displaced from their positions, with the exception of the one marked "B."

This figure had been blown towards the door, and the cotton lining of the "fly" of the trousers was found to be on fire.

The building did not catch fire; this was probably due to the interior having been recently saturated with water in extinguishing the fire caused by a previous Experiment (p. 80).

From observations made of the dummy figures, it would appear, that with the exception of the suit of new clothing the *front of the safety jacket of the remaining suits were considerably damaged.* This was no doubt due to the loose fit of the jacket. It is suggested, as a remedy for this, that the form of the jacket should be similar to that of a "Norfolk" jacket pattern, which is longer and close fitting; also the opening in front of the cloth trousers should be of the "flap" pattern, which would no doubt afford greater protection to the lower part of the body than the present pattern

APPENDIX Z.

Experiments with varieties of percussion caps, carried out in the Royal Laboratory, Woolwich, on 26th September, 1894 (compare with experiments at page 117 of Annual Report, 1885).

Present.

Colonel Majendie, C.B.
Captain Thomson, R.A.
Colonel Barlow, R.A.
Captain Waring, R.A. } Assistant Superintendents,
Captain Strange, R.A. } Royal Laboratory.
Mr. Ayling, and others.

For the purposes of these experiments there had been supplied caps for ·303 cartridges, filled as follows:—

	Distinguishing No.
(1.) With ·3 grains, Martini-Henry composition (as below)	3 M.
(2.) With ·4 grains, ditto ditto	4 M.
(3.) With ·3 grains, Cordite composition (as below)	3 C.
(4.) With ·4 grains, ditto	4 C.
(5.) With ·6 grains, ditto	6 C.

For convenience these are referred to by the distinguishing figures given in last column above.

Composition.

Martini-Henry Cap Composition.

Fulminate of mercury	6 parts.
Chlorate of potash	6 „
Sulphide of antimony	4 „

Cordite Cap Composition.

Fulminate of mercury	6 parts.
Chlorate of potash	14 „
Sulphide of antimony	18 „
Powder, mealed	1 „
Sulphur, ground	1 „

Experiment A.

For the purposes of this experiment there had been supplied a number of cylindrical tin boxes, 1½ inches diameter and 1¾ inches high. The different varieties of caps were placed in separate boxes, 100 in each, the lid of the box being left off. The caps were exploded by application of a red-hot iron to one cap in each box.

—	Result.	Remarks.
(1.) 3 M.	Only 3 fired.	—
(2.) No. 1 (repeated).	Ditto.	—
(3.) 4 M.	Ditto.	—
(4.) 3 C.	1 fired.	—
(5.) No. 4 (repeated).	3 fired.	—
(6.) 4 C.	5 fired.	—
(7.) 6 C.	18 fired.	Quite an energetic ignition.
(8.) No. 7 (repeated).	5 fired.	—

Experiment B.

The arrangements and boxes were the same as for A., except that the lids were on the boxes, and a hole was made in each lid to admit a steel implement, one end of which was inserted in a cap resting on the bottom of the box. A weight of 5 ounces allowed to fall 13 inches.

—	Result.	Remarks.
(1.) 3 M.	Only 1 fired.	—
(2.) 4 M.	23 exploded.	Lid blown off. Brisk action.
(3.) 3 C.	1 fired.	—
(4.) 4 C.	1 fired.	—
(5.) 6 C.	1 fired.	—
(6.) No. 2 (repeated).	1 fired.	—

Experiment C.

This was a repetition of A., using, however, caps taken direct from the steam bath, the temperature of which was about 211 or 212° Fahrenheit. The caps were so warm that it was difficult to handle them in the naked hand.

—	Result.	Remarks.
(1.) 3 M.	27 fired.	Brisk crepitation, and succeeding pops.
(2.) 4 M.	29 fired.	
(3.) 3 C.	8 fired.	Slight action.
(4.) 4 C.	10 fired.	
(5.) 6 C.	38 fired.	Very brisk; 26 blown out of box.
(6.) Repetition of (5).	95 fired.	Very energetic.

Experiment D.

Caps heated as per C., and fired by falling weight as in B.

—	Result.	Remarks.
(1.) 3 M.	15 fired.	—
(2.) 4 M.	96 fired.	Pretty brisk, and fizzling action.
(3.) 3 C.	2 fired.	—
(4.) 4 C.	5 fired.	—
(5.) 6 C.	—	Accumulative fizzling action, and caps continued to pop off for some minutes.

Experiment E.

Caps heated as in C. and D. They were subject to the following rough treatment :—

(*a.*) Box containing 100 shaken violently by hand, in a tray with ridges in the interior.

(*b.*) Same box thrown two or three times into air, from 20 feet to 25 feet, and allowed to fall on to iron floor.

1st. Five sorts of caps were shaken, as above. No result.

2nd. Then the boxes were thrown about 20 feet into air, falling on iron floor. No result, except in the case of the 6 C. caps, which fell (by accident) on wooden planks, and yet one fired, and this apparently from its having come into contact with a piece of sharp metal inside the box (which was not in cap box).

Experiment F.

5,000 caps (4 C.) contained in a tin box, had a charge of 4 grains (= charge of 10 caps) of loose Cordite composition, to serve as a primer, placed in the midst, and the loose charge was fired by electricity, the box containing the caps being placed in a stout iron box.

A sharpish explosion, top of the tin cap box blown off, and the box rather disfigured. No other damage. A *large* proportion of the caps not fired.

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ALBION COLLIERY EXPLOSION.

REPORTS

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

DISASTER AT ALBION COLLIERY, CILFYNYDD, NEAR PONTYPRIDD,

On the 23rd June 1894;

BY

J. ROSKILL, Esq.,
BARRISTER-AT-LAW;

AND BY

J. T. ROBSON, Esq., HENRY HALL, Esq., AND JOSEPH S. MARTIN, Esq.,
HER MAJESTY'S INSPECTORS OF MINES.

Presented to both Houses of Parliament by Command of Her Majesty.

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1895.

[C.—7655.] *Price* 2*s.* 4½*d.*

REPORT

TO

THE SECRETARY OF STATE

ON THE

Disaster at Albion Colliery, Cilfynydd, near Pontypridd, on the 23rd June 1894.

BY

J. ROSKILL, Esq.,

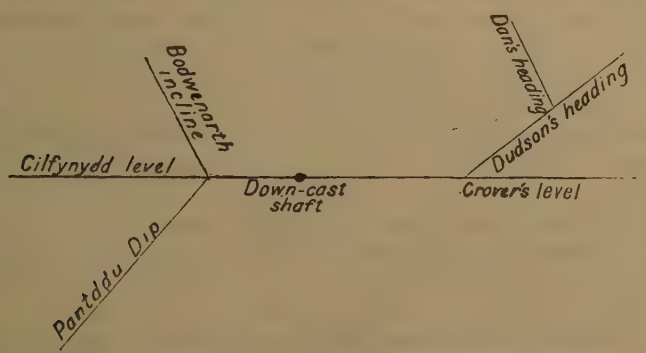
BARRISTER-AT-LAW.

On Saturday afternoon, June 23rd, 1894, between a quarter and ten minutes to four an explosion occurred in the Albion Colliery (upper four-foot seam), Cilfynydd. The night shift was then at work, and though no record was taken of the number and names of the men who went down in the shift it is clear that nearly 300 were in the mine. The morning shift on that day consisted of over 1,000 men. The result of the explosion was appalling. It has caused the death of at least 288 men; of these 10 were brought out alive but have since died of the injuries they received, and one body was recovered and identified as late as July 22nd. Only six have survived, and two of them, Thomas Howells and Richard Bumford, gave evidence at the adjourned inquest.

P. Jones, 53. H. Lewis, 1258. P. Jones, 244. R. Griffiths, 786. Thomas Howells, 721. R. Bumford, 735.

The colliery, as appears from the accompanying plan, is one of considerable size. There are three main hauling roads on each side of the shaft; Grover's

Description of the mine. Scale of plan 4 chains (88 yards) to an inch.



Sketch, showing the main hauling roads.

level, Dudson's heading, and Dan's heading, on Grover's side; Cilfynydd level, Pantddu Dip, and Bodwenarth incline on the Cilfynydd side. In Grover's level and Dudson's heading the rise is about an inch to the yard. Dan's heading rises about 2 inches to the yard. The Cilfynydd level rises about an inch to the yard up to the face. Pantddu dip is flat from the lamp station adjoining Cilfynydd level for a distance just beyond the red line marked on the plan across the dip; here there is a "fault," and from this point the dip rises 3 or 4 inches to the yard as far as the next lamp station, and thence to the face, 2 inches to the yard. Bodwenarth incline rises not more than an inch to the yard, and portions of it are level. The depth of the downcast pit to the four-foot landing, which leads to this four-foot seam, is 545 yards. It is due north of the upcast pit; Grover and Cilfynydd

H. G. Hill, 5. P. Jones, 27–8. P. Jones, 29. H. G. Hill, 4.

levels running north-west and south-east respectively. The whole of the pink portion on the plan indicates that coal has been worked out.

The mine is divided into eight districts marked 1 *a*, 1 *b*, 2 *a*, 2 *b*, 3 *a*, 3 *b*, 4 *a*, and 4 *b* on the plan.

The mine dry and dusty. How it was watered.
P. Jones, 145, 185.
W. Rees, 410–12.

The mine was admitted to be dry and dusty, and it is therefore important to consider what means were adopted or available for watering it. The blue portions on the plan are supposed to indicate the wet places, but this applies to the ground only, and not to the sides or roof, and is, moreover, to be understood to show not so much that the places are naturally wet, but that water could there be let down the roads by means of taps, casks, or pipes.

P. Jones, 74.

P. Jones, 76.

See No. 126 on plan.

For instance, Grover's level is watered by a tap near the stables, or by means of holes punctured in pipes, laid along the ground on the north side, through which water in a "fault" there is pumped out, by means of a horse pump to the shaft. A wooden plug is kept in each of these holes, and when withdrawn causes a small jet of water to come out with some force, which reaches the opposite *side of the road but not the roof.* There are about 20 of these holes between the horse pump dip and the lamp station towards the pit, a distance of 374 yards, and the manager Philip Jones said he relied more on the tap than upon these holes in the pipes, for watering this distance. The tap would *be kept running for a quarter to half an hour every day.* Occasionally casks *of water are turned over on the road in Grover's level, but the sides and roof are not sprinkled.*

P. Jones, 158.
H. G. Hill, 158.

P. Jones, 159.

P. Jones, 160.
P. Jones, 163.

Pantddu dip, the wettest portion of the mine.
P. Jones, 78–9, 164.

Pantddu dip is much wetter than Grover's level; there is a pump in the dip by David Thomas' level which discharges water into a large tank, placed in a hollow on the side of the road about 10 yards from the lamp station by Mordecai's level; from this tank pipes carry the water away to the pit, they are laid on the side of the road, and there is frequently an overflow of water from holes in them. The water remains stationary in the flat portion of the dip, creating a vapour that damps the roof and sides.

Bodwenarth incline, from the first level down to Cilfynydd level, is watered by means of a pump in the return, the water running over the roadway. The levels and dips above, nearer the faces, are watered from casks, but only the ground, and not the sides and roof, which are dry and dusty.

Wm. Davies, 619.
John Jenkins, 645–7.
P. Jones, 79, 80.

The wet places, indicated by the blue patches on the plan, in the far end of Cilfynydd level are caused by water dropping from the roof. No other appliances, but those above specified, were in actual use at the time of the explosion for the purpose of watering the mine, and laying the dust; but about six months before, 2,000 yards of pipes were laid along Dan's and Dudson's headings and Cilfynydd level, with the object of watering by means of sprays, intended to saturate the air and impregnate it with moisture. The sprays, however, although ordered as far back as 22nd January 1894, were only delivered a week before the explosion, and were not fixed or in use. This plan of watering was decided upon by the managing director, Mr. Henry Lewis, the agent, Mr. William Lewis, and the manager, after consultation, and before, and not in consequence of the publication of Mr. Hall's Report to the Royal Commission on Explosions from Coal Dust in Mines, in which the dust from this colliery is stated to have "excelled all others in violence and sensitiveness to explosion." This Report was issued on the 12th February 1894, and a copy was first received by them about the end of that month, whereas the pipes and sprays had been ordered in January. Still, the explosive nature of the dust was known to them, and it was for that reason, and by way of additional precaution, that they resolved to adopt this new method of watering. Moreover, in or about December last year, Mr. Sims, one of the assistant inspectors, spoke to the manager with regard to the use of better appliances for watering, and suggested the method of sprays. The mine is worked on the long wall system, and by double shifts.

P Jones, 75.
New method of watering by means of sprays decided upon, but not yet in use.
H. Lewis, 1230.

Wm. Lewis, 968.
P. Jones, 75.

Wm. Lewis, 967.

Dangerous nature of the dust in this mine.
See p. 15 of Mr. Hall's Report. [C.-7185, 1893.]

P. Jones, 77.

J. M. Sims, 1626.

P. Jones, 35.

Alteration in the Saturday night shift made a few weeks before the explosion at the request of the men.
P. Jones, 61.
W. Garnett, 333–4.
H. Lewis, 1224.

Until within a few weeks of the explosion, the Saturday day shift was from 7 a.m. to 2 p.m., and the night shift began at 3 and ended at 8.30; there was a second night shift on Saturdays that went down at 10. At the request of the men a change was made in the Saturday night shifts, and it was decided to have only one night shift, *and that it should go down at 2 p.m.* There was thus no interval between the day and night shift on Saturdays.

No interval between the day and night shift on Saturdays.
P. Jones, 46.
Wm. Garnett, 334.
Wm. Rees, 413.
Wm. Lewis, 1006, 1012.
J. T. Robson, 1566.

Most of the clearing of dust and rubbish was done by the Saturday night shift, and when there was blasting it almost always took place on Saturdays, in the intervals between the shifts. This was in itself dangerous, as stated by Mr. Robson, the chief inspector for the district, in his evidence, because the atmosphere of the mine would already be saturated with fine coal dust from the process of clearing and dusting.

Wm. Garnett, 334.

Before the alteration in the Saturday night shift there were two intervals between the shifts; the first from 2 to 3 in the afternoon, and the second between the two night shifts. When the new arrangement was made, a difficulty and danger clearly arose with regard to the time when blasting was to take place, but no *new* regulations as to shot-firing were made, nor any warning given against its being carried on during the shifts.

P. Jones, 62.

The manager endeavoured to explain away this difficulty by alleging that an interval of half an hour would elapse between the shifts; because the day shift began to come out at 1.30, and in that half hour, before the night shift went down, shots that had to be exploded would be fired. The agent, while admitting that no special instructions as to shot-firing had been given, when the alteration in the Saturday night shift was made, said that there might still be a short interval between the shifts, and similar excuses were put forward by some of the officials of the mine.

Wm. Lewis, 966.

H. Lewis, 1225.

The managing director, while not disavowing the above explanation of the manager, admitted that he *overlooked* the whole question of shot-firing when the change in the night shift was decided on. He said, "I never "thought of the difficulty of shot-firing at the time we gave way; we were "pressed by these people (meaning the representatives of the men)—the "consequence never occurred to me at the time." It is, however, quite clear, from the evidence of the banksman W. J. Howell, that there was no interval whatever between the two shifts on Saturdays since the new arrangement. He said that the general practice was for the night men to go down in one cage, while that on the other side of the pit or shaft was bringing up the day men, and *after* two o'clock on the afternoon of the explosion he wound up 200 to 300 day men.

H. Lewis, 1224.

W. J. Howell, 949–50.

Timbers blasted in the mine since five years.
P. Jones, 61.
H. Lewis, 1203.
H. Hall, 1538.
J. T. Robson, 1554.
J. M. Sims, 1635.
P. Jones, 150.

For the last five years it has been usual in this mine to blast the timbers used as supports for the sides and roof in double partings, and probably also in other portions of the mine, which required to be removed. That this was done was entirely unknown to the inspectors, who, before this explosion, had never heard of it either in this or any other colliery. There is nothing in the Coal Mines Regulation Act, 1887 (50 & 51 Vict. c. 58), that, subject to the precautions prescribed by the Act being observed, renders blasting in timber illegal, or indeed specifically deals with it, for it seems clear that such a practice never was or could have been contemplated.

Not prohibited by the Coal Mines Regulation Act, 1887.

J. T. Robson, 1554.

The inspectors strongly disapprove of it, and Mr. Robson said that, had he been informed, he would have taken steps under section 42 of the Act, with the object of having this practice discontinued. The manager alleged that he had known of it in other collieries for over 20 years, and referred to Penrhiwceiber and Nixon's Collieries; but, when pressed, he could give no other instance than the former colliery, and that as far back as 9 or 10 years ago. Nor could the managing director give a more recent case of blasting timber in any other colliery than one 10 years ago in the Ynysfeio mine, which was then under his own management.

P. Jones, 61, 214.

H. Lewis, 1239.

D. Hannah, 1374–5.

Mr. Hannah, agent for the Ferndale Collieries, who was called on behalf of the proprietors, said that, having made inquiries since this explosion, he was told that they had recently blasted timber at Ferndale, but not in the four-foot seam, and that he had given instructions to stop it. Mr. Bramwell, agent of the Great Western Colliery, another mining engineer, called as a witness on behalf of the owners, gave it as his opinion that "provided proper precautions are carried out as stated in the Act," he did not consider it more dangerous to blast in timber than in rock; but, he said, timber was not blasted in the Great Western Colliery, where they have almost stopped blasting altogether. It will be necessary to discuss this practice, and the precautions alleged to have been taken in connexion with it in some detail, in considering the evidence, for it is the opinion of the inspectors that the explosion was caused by blasting timber at a point on Grover's level, 35 to 40

H. Bramwell, 1397.

Theory of the inspectors that blasting timber at the point marked A. on the plan caused the explosion.

yards on the in-by side (*i.e.*, towards the face) of the horse pump dip; this point I have marked A on the plan. It is denied by the owners and officials of the mine that the timber at or near this point was blasted at all, and the theory put forward by them is that the explosion was caused by a sudden fall of rock roof at the point which I have marked B, where the pillar and the old workings on the Cilfynydd level adjoin, the fall being partly in the former and partly in the latter, and its length about 24 yards. In their opinion an accumulation of gas was here pressing down upon the rock roof, both causing and liberated by the fall, and coming into contact with the "comets" or naked lights, that were placed between the lamp station inside that point and the shaft, was ignited, and caused the explosion. At least 117,000 cubic feet of air per minute passed the point B.

Owners deny that timbers at A blasted at all, and say the explosion was caused through an outburst of gas at the point marked B on the plan.

D. Hannah, 1347.
H. Lewis, 1231.
P. Jones, 87.

I would also refer to two other points which I have marked C and D on the plan. At the point C on the Cilfynydd double parting (where there is a double set of rails), just outside William Rees' heading, six holes in timbers were prepared and charged on that Saturday morning, and the evidence shows clearly, in my opinion, that these shots were fired *after* 2 o'clock and before the explosion. The point D is on the in-by side of the lamp station on the double parting between Llanfabon dip and Askett's heading. Orders had been given by William Rees, the day overman, for shots to be prepared and fired here in two pairs of timbers 8 feet apart, that is, in four "arms" and two "collars" (a "pair of timbers" consists of two "arms" and a "collar"; the arms support the two sides, and the collar is placed across them at the top and supports the roof). These timbers had been "squeezed" or pressed down by the roof. Five shots were prepared in them at half-past 1 on the Saturday of the explosion, one shot in each of the four arms and one in one of the collars, but they were not fired before the explosion. After the explosion the shots in the four arms were found unexploded, that in the collar having gone off. It seems clear that this last shot must have been put off by the explosion and that it was not fired in the ordinary way.

Timbers at point C on plan charged on the morning of the explosion.

Morgan Dyer, 657.
Wm. Rees, 414.
Wm. Garnett, 338.
Eli Holly, 558.
P. Jones, 68.
Wm. Rees, 416.

Charges in timbers at the point D. found unexploded after the disaster.

Wm. Rees, 415.
Price Wilson, 935–6.
Wm. Rees, 418–9.

There are two engine-houses for hauling purposes in the mine—one on Grover's, the other on the Cilfynydd side; they are built on platforms above the levels in each case, from which they are approached by ladders. The boilers are constructed between the levels and the return, as shown on the plan.

P. Jones, 96.

The clutch of the Grover's side engine broke and failed to act at about 1 o'clock p.m. on the day of the explosion, and no hauling could be proceeded with on that side in consequence. The boiler fires on the Cilfynydd side were extinguished by the manager as soon as he came down after the explosion.

P. Jones, 216.
Wm. Rees, 418–19.
P. Jones, 85.

Good system of ventilation in mine.

The ventilation of the mine is very good; it is ventilated by a Schiele fan, 15½ feet in diameter, making 48 revolutions per minute; there are 11 "splits," and the manager gave the figures showing the quantity of air along each of them, as measured and recorded by him on June 20th last. The total quantity of air driven into the pit was 246,202 cubic feet per minute.

P. Jones, 29–36.

Extent of explosion due to coal dust.

Apart from the magnitude of the disaster, the present inquiry has an added importance and interest from the light thrown by the evidence upon, and the ample and abounding confirmation it affords of the coal-dust theory in explosions. There can be no doubt, and indeed it was admitted by all the witnesses to whom the question was put, that, whatever the cause, and wherever the initial source of the explosion, its extent and the intensity of its ravages were due to the coal dust in the mine. Leaving for the moment the controversy whether the origin of the explosion was at point A or at point B, this at least is clear, that on the in-by side of A (*i.e.*, the side remote from the shaft) the force and direction of the blast were *inwards*, towards the faces, following the direction of the airways, going up Askett's heading and down Llanfabon dip; further, outside the point A, going up Dudson's and Dan's headings towards the faces, similarly, on the in-by side of B going up Bodwenarth incline, Cilfynydd level and down Pantddu dip.

Ap P. Jones, 173.

The gathering force and added violence of the blast as it went along these several places is shown more particularly by the awful mulitation of the bodies found at very long distances from the level between points A and B. Thus, 40 yards down Llanfabon dip (Grover's side) the body of Richard Owen, a

haulier, was found (see No. 128 on the plan); his head was 20 to 25 yards further down the dip; and, three or four yards from his body, his leg was found literally torn off from above the knee. There were two trams above him, but nearer the level, so that it is quite clear, in my opinion, that the terrible injuries he received were due, not to any violent collision with the trams, but solely to the force of the explosion. P. Jones, 125–6. Wm. Garnett, 350. Dr. Lyttle, 915. Wm. Garnett, 350.

In John Morris' dip (Grover's side) the body of a man fearfully disfigured and burnt, so that he could not be recognised, was found (No. 139 on the plan); his leg was missing, and was only found on July 17th. Wm. Garnett, 355–6. Wm. Garnett, 352–4.

Again, at the bottom of Askett's heading (Grover's level), near the top of John Morris' dip (Nos. 110, &c., on the plan) six men were found dead and very much battered, and an arm was afterwards found there.

At the bottom of Sergeant's heading (Dudson's level, No. 122 on the plan) the body of David Evans was discovered, with limbs torn off, so that he could not be identified until his clothes were recognised by relatives. Going from this point for a distance of at least a mile and a half along the levels to the bottom of David Rees' level (the first on the left up Bodwenarth incline) the body of a man lay there (No. 42 on the plan), with head and foot knocked off. As these were found close to his body, it is possible that the blast, in this instance, forced the man against some trams that were near, and that the mutilation was in part due to this. Again, at a point about 100 yards outside the point C (*i.e.*, towards the shaft) were three bodies, too much torn and injured to be recognised. Henry Hill, 600. Wm. Davies, 624, 642. Morgan Dyer, 659. Wm. Davies, 623.

The above, except for two instances between the points A. and B., to which reference will be made, are the only cases of mutilation disclosed by the evidence, thus illustrating, by the long distance between them, and by the fact that many other men were found suffocated in the levels and headings lying within the space bounded by these several points of excessive violence, that the explosion gathered and fed on the coal dust, the force of the blast increasing in intensity as it proceeded.

Slight indications of force in Pantddu dip owing to its damp condition.

It is, moreover, remarkable that the indications of force in Pantddu dip are slight; the timbers there are not even injured, and showed no traces of the explosion. This is due to the fact that Pantddu is the wettest portion of the mine, so that there was hardly any dry coal dust to feed the blast. About 38 men were found in the wet portion of the dip, all suffocated but 11, who were still living. Of these 11 men six are alive, the only survivors of the explosion; five or six men were brought up alive from Grover's side, but all these have since died. There were no bodies found between that portion of Pantddu and the faces; and, in the opinion of the day fireman of this district, Henry Watkins, if these 38 men had remained on Mordecai's level, where they were working, instead of coming into the dip, where the after-damp reached them, they would have been saved, for the horses in that level were all found alive. Thomas Howells and Richard Bumford, the two survivors who gave evidence, were able to reach the top of the dip, for they were found on Cilfynydd level, one in the lamp station, the other in a manhole just outside it. P. Jones, 164. Henry Watkins, 706. P. Jones, 164. H. Watkins, 704. Wm. Lewis, 987. H. Watkins, 716–17. R. Bumford, 743. H. Watkins, 705–6.

Although the instances of mutilation described above are, from their positions and their distances from the centre of the explosion, whether that is to be placed at point A or point B, conclusive, in my opinion, to prove that the ravages caused by the explosion are due to coal dust, there are two other instances of mutilation *between* A and B, showing, apart from other indications, that the blast, along a portion of that distance, must have been of great violence. The pitman, James Graves, who went down the shaft with the first "bond" after the explosion, speaks to finding a head and, he believes, portions of a body in the "sump," that is, the bottom of the downcast shaft. These remains, in his opinion, were part of a body found on the Cilfynydd side which had been blown to pieces. No other witness directly confirms Graves upon this, but William Garnett (night fireman Grover's side), who also descended in the first cage after the explosion, mentions that they had to trample on the limbs of some bodies close to the shaft. Neither the manager nor the under manager, who were also among the first to go down, spoke to the finding of these remains in the "sump." But though there may be some doubt as to this, it seems clear that, at the bottom of Dudson's heading on James Graves 74, 776. James Graves, 782. Wm. Garnett, 381.

Grover's level (No. 137 on the plan), just by the lamp station there, a large number of bodies were found, and two of these, Thomas Winter and Thomas Evans, had received very great injuries, the former having both arms broken, and the latter having received violent blows on the head, and all the men there were burnt. Three, however, were found alive and have since died; and, although there were signs of very great violence along Dudson's heading, as indicated by the fall there, there was no instance of mutilation as great as those outside the space between A and B, that have been described, and the condition of Dudson's heading after the explosion neither weakens, nor indeed affects, the conclusion that its excessive violence, at the points far distant from each other that have been specified, was due to coal dust and to nothing else. Between Dudson's heading and the horse-pump dip *no bodies* were found on Grover's level, and the plan is not correct as to this.

P. Jones, 88. Wm. Garnett, 342. Henry Hall, 1512. Wm. Garnet, 343.

Fifty-four witnesses called at this inquiry.

Fifty-four witnesses gave evidence at the adjourned inquest, and several were recalled in the course of the proceedings. Of these 33 (including the managing director, agent, and manager) were officials or men engaged in and about the mine, whose evidence of the system adopted in working it, and of the results of the explosion, was mainly on behalf of the owners and of their theory as to its cause, and four mining engineers were also called in support of this theory. Eleven witnesses were called on behalf of the men, and, finally, Dr. Lyttle, the surgeon to the Albion Colliery workmen, and the five inspectors who were present. In addition to the chief inspector of the district, Mr. J. T. Robson, and the two assistant inspectors, Mr. J. M. Sims and Mr. F. A. Gray, Mr. Henry Hall and Mr. J. S. Martin, the chief inspectors for the Liverpool and Western districts respectively, also gave evidence.

The colliery proprietors and officials were represented by counsel, and also the relatives of those of the deceased men who belonged to the Cambrian Association of Miners.

Duration of inquiry.

The inquiry lasted nine days, the court frequently sitting for nearly 11 hours, and the whole of the evidence was followed with care and intelligence by the jury, many of whom had practical knowledge of mining.

Analysis of the evidence, its division under five heads.

It will be convenient to divide the evidence under the following heads:—

1. *Blasting in timber*, when and under what circumstances it was done, with what precautions as to tamping and watering, and with what explosives. Offences disclosed by this evidence.

2. *Indications of force in Grover's level*, having regard to the theory of the inspectors that the explosion originated at the point A, and evidence as to the alleged blasting of timbers at that point.

3. *Direction of force in the Cilfynydd level*, from the point B to the shaft; evidence in support of the theory of the owners, that the initial source of the explosion was at the point B.

4. *Conclusions as to the cause of the explosion* and *other questions arising on the evidence.*

5. *The question of negligence, and of offences against the Coal Mines Regulation Act*, 1887.

Evidence as to the blasting of timbers.

1. *Blasting in Timber.*

P. Jones, 61, 149–51. Wm. Rees, 443. W. Jones, 856. P. Jones, 52–3, 60. Wm. Rees, 466. Wm. Garnett, 366. W. Austes, 913–4. Wm. Garnett, 330. Wm. Garnett, 374. Wm. Rees, 417.

The reason given by the manager, among other witnesses, for blasting timbers, which he said was only done in double partings and under a rock top, was that it was not safe for the men to hew them out when they had to be removed. According to his account, holes were bored with an auger in each arm, about two feet (but according to the day overman, William Rees, only a few inches) from the ground, and in the middle of the collar against the top. Each charge would contain 2 to $2\frac{1}{2}$ ounces of dynamite, and was fired with touch paper by the fireman, which he lit by placing it against the gauze of his lamp, and then put to the fuse, which was thus ignited. The holes, according to William Garnett (night fireman Grover's side, district 1*a*), would generally be charged *during the day shift*, and it seems to have been usual for holes to be charged then, and only fired some hours later. In Garnett's opinion this is safe "if we can cover the fuse and no traffic is

by ;" and the under manager said he thought it right to leave shots charged throughout a shift, if no one was working within 150 yards. The holes were bored about 9 to 11 inches deep, *i.e.*, about three parts through the timber, as stated by the chargeman, William Anstes, and the charge takes up two to three inches in depth.

W. Jones, 837–8.
W. Anstes, 924.

The manager insisted, in his evidence, that such shots were fired only *between* shifts, and in this he was confirmed by Garnett, the night fireman, and to some extent by the managing director and the agent; but as blasting in timber was mainly done on Saturdays, and there was no interval between the two Saturday shifts since the alteration in the night shift already stated, I am of opinion that the evidence of the manager, and of those who confirmed him upon this point, cannot be relied upon, so far as it deals with blasting in timber since the new arrangement in the night shift.

W. Garnett, 332.
H. Lewis, 1225.
Wm. Lewis, 965.

A certificate, dated 10th April *1892*, was put in by the manager, appointing Morgan Dyer and Edward Rees as shot firemen in these terms: "The said "work must be carried out by the said persons in accordance with the Mines "Act, and no shots fired only *between* shifts." David Griffiths having been appointed instead of Edward Rees, the certificate appointing him, dated *21st May 1894*, states that "he must carry out the above instructions" (meaning those in the certificate of the 10th April 1892). Now at the date of the second certificate, 21st May 1894, the alteration in the Saturday night shift had already taken place, and nevertheless, no new or special precautions are contained in it against blasting at other times than between shifts. The matter was simply overlooked, and the result was what might be expected, and there is abundant evidence that blasting on Saturdays took place during the night shift. Both the survivors, Howells and Bumford, speak to this, and so do six of the witnesses called on behalf of the men.

P. Jones, 63.
H. Lewis, 1224.

Blasting during night shift on Saturdays.
T. Howells, 725–6.
R. Bumford, 752, 760–1, 765.
James Davies, 1057.
Thomas Owen, 1092.
J. R. Evans, 1116–17.
Edward Lewis, 1123–4.
George Colwell, 1152–4.
H. B. Jones, 1161.
Rowland Williams, 1331–33.

On the day of the explosion itself, this must have been the case with the timbers at the point marked C on the plan. On that Saturday morning Anstes, the chargeman, was instructed by the night overman to charge six holes in timber in the Cilfynydd double parting at the point C, and two holes in the solid rock in Bodwenarth district, on John Roberts' dip; this he did, having himself drilled the holes in the timber with an auger.

The shots in the rock in Bodwenarth *were not fired*, and the charges were found there unexploded after the disaster. Anstes' duties, as chargeman, were confined to the Cilfynydd side, and he said that these timbers, at the point C., were the first he had charged since the alteration in the Saturday night shift, that would be since about five weeks.

Timbers at point C blasted during night shift.
W. Anstes, 917–19.
John Jenkins, 647.
W. Anstes, 911.
John Jenkins, 648.
W. Anstes, 911.

Now the person whose duty it was to fire these charges was either John Evans (night overman), or most probably David Griffiths (night fireman). On this Saturday the day fireman, Morgan Dyer, came out of the pit at 2, or five minutes past, and, as he came up, the men of the night shift were going down, "in the ordinary course," as he says. At the top of the pit he met both John Evans and David Griffiths, and told the latter, as the man who would naturally fire them, of these six shots at the point C (the shots were in four arms and two collars); he did not tell John Evans. Now the distance of the point C from the bottom of the downcast pit is 36 chains (792 yards); moreover, before going to fire these timbers Griffiths had to lock the lamps at the lamp station on the Cilfynydd side, and this would take half an hour. *He could not then have reached these timbers at point C until 20 minutes to 3.* The indications after the explosion at this point, as disclosed by the evidence, show clearly, in my opinion, that these shots in the timbers were fired by Griffiths, and not by the explosion. Just outside this point (*i.e.*, nearer the shaft) there was a tram filled with rubbish; the bodies of the haulier and the timberman's "butty," or assistant, and of the horse, were close to the tram. Some hatchets were also found there. The fall at that point was not big, and one body was found under it. All this points to the tram having been loaded by these men after the fall had been caused by the firing of the shots. The body of David Griffiths was found in David Morgan's dip, about 190 yards from the point C. This, and the evidence that the rubbish caused by the fall had been loaded on to the tram by the men is sufficient to show, apart from other indications, that at whatever time during the night shift these shots were in fact fired, they cannot have caused

Morgan Dyer, 657, 663.
Morgan Dyer, 661–63.
H. Hill, 664.
Morgan Dyer, 664.
M. Dyer, 665–66.
Morgan Dyer, 658.

the explosion; but in any case I am of opinion that on the day of the explosion the shots at the point C were fired *during* the shift.

Charges in timber not properly tamped or stemmed.

W. Anstes, 924–5.
P. Jones, 145–6, 186–7.
Wm. Garnett, 363–375.
Wm. Rees, 453.
H. Lewis, 1335–6.
H. Hall, 1534.

A matter of great importance in connexion with the risks involved through blasting in timber as above described, is whether the charges are properly tamped or stemmed, so as to prevent the flame caused by firing the charge from blowing outwards. The evidence on this point is quite clear. Anstes, the chargeman, when asked how he stemmed the charges, said he took "a little horse refuse or a bit of clay substance" and put it *on*, not *in*, the mouth of the hole. No shale or coal dust was used for tamping, but anything soft or moist that lay on the road. It thus appears that only the mouth of the hole was covered; and in Mr. Hall's opinion, what was described as tamping is of "no earthly use at all"; he said there was, in effect, no tamping, because what was done did not prevent the shot discharging outwards. Tamping was defined by Mr. Hall to be "sometimes ribble put "on the charge and tamped under it some considerable length, say 18 inches." Now it has been already mentioned that the depth of a hole bored in timber for the charge to be inserted, was not more than 9 to 11 inches; and it appears from the evidence of the manager and of the chargeman that the charge in timber would weigh about two ounces. In the holes in rock on the Bodwenarth side that were charged by Anstes on the day of the explosion, the charge put in was not more than four or five ounces. It seems to follow that, although the charge in a hole in rock was greater than that used in timber, proper tamping of the charge in timber was nevertheless impossible, the depth of the hole being too shallow to admit of it.

H. Lewis, 1235.
W. Anstes, 924.

P. Jones, 52–3, 60.
W. Anstes, 925.

Contention of manager and others that timbers only blasted in double partings. This denied by other witnesses.

P. Jones, 252, 267.
Wm. Garnett, 391.
Wm. Rees, 453.
J. Jenkins, 654.
Wm. Lewis, 965.
James Davies, 1057–62, 1067, 1083–4.

It was alleged by the manager and other witnesses that timber was only blasted in double partings, where the roads are wide, two sets of rails being there, and under rock roof; and if this were so, the contention that the timbers at the point A could never have been blasted at all, as they were on the level and under "clift" roof, would have considerable weight. But there is evidence that timbers have been blasted in the levels, and not only under rock roof, and some of the witnesses called on behalf of the men had no doubt that this was so. James Davies, a ripper, knew of shot-firing in timber in Grover's level, between the double parting and Tom Williams' heading, and also at the bottom of this heading; and has seen both 13 feet and 7 feet "collars" blasted there two months before the explosion. He worked on the night shift, but had been ill for some weeks before the explosion and was not in the mine that afternoon.

Thomas Owen, 1095–6.

Thomas Owen, rock ripper, said that short "collars" had been blasted on the main levels three or four months before the explosion, when there would have been no danger in cutting out the timbers, the sole reason for blasting them being that it was quicker to fire the timber than to hew it; and another rock ripper, J. R. Evans, said he had seen "collars" of all sizes blasted.

John R. Evans, 1117. *See also* H. B. Jones, 1161.
G. Colwill, 1154–5.

George Colwill, a collier who was called on behalf of the men, and who passed Grover's level daily on his way to Tom Williams' heading, where he worked in the *day shift*, said that though he has not known timber to be blasted in that level before the end of the *day shift*, rock has been blasted on the parting at about half-past 1, before or as he was leaving his work; but he has not seen this done since last November.

H. Hall, 1439.

Upon this point Mr. Hall's opinion was that if the men had been taught that it was not dangerous to fire shots on double partings, they would do so wherever it happened to be convenient to them.

P. Jones, 212.
W. Jones, 839.

Neither the manager nor the under manager ever saw a shot fired in timber, or personally superintended the blasting, or the arrangements for watering in connexion with it, so that shots might have been fired on levels without their knowing of it. Between these contradictory statements by the witnesses, I think that, although it may not have been usual to blast timber except in double partings, there is some ground for supposing that it has been done in short collars, and on the levels, merely to save labour, and even where there was no rock top.

Precautions as to watering, when shots were fired.
P. Jones, 197.

Again, upon the subject of the precautions with regard to watering, when shots were fired, the evidence is unsatisfactory. The manager said that the firemen used to splash water with their hands from a bucket, on to the sides

and roof for a distance of 20 yards on each side of the hole, and in his opinion this was sufficient. According to the fireman, Garnett, the chargeman would water the place for the distance and in the manner spoken to by the manager. The day overman, William Rees, stated that the water was thus thrown about "with buckets, shovels, or the hand, or anything of the kind." The chargeman, Anstes, said he watered the places himself, but not always the roof where the place was damp, as, for instance, in Pantddu dip. The day fireman on the Cilfynydd side, Morgan Dyer, confirmed this, and so did the under-manager, who, however, as already mentioned, was never himself present; and although he was responsible for proper precautions being taken in blasting timbers, he admitted to me that John Evans (the night overman) might have blasted them without his knowledge.

W. Garnett, 390-1.
Wm. Rees, 442.
W. Anstes, 922-3.
M. Dyer, 673.
W. Jones, 826.

On the other hand, seven witnesses stated that shots were fired without any precautions as to watering. Thomas Howells, a ripper working on the Cilfynydd side, one of the two survivors, never saw watering done, and the other survivor, Bumford, confirms this. To the same effect is the evidence of five witnesses called on behalf of the men. The conclusion I have come to upon this portion of the evidence is, that although the alleged precautions as to watering may have been taken occasionally, they were not adopted regularly as, in a matter involving such risk, they might and should have been; and further, that there was insufficient control and superintendence over those who had charge of the shot-firing. With regard to watering generally, and apart from shot-firing, in the mine, owing to its dry and dusty nature, Mr. Robson said that the system adopted was inadequate to prevent an explosion travelling over the mine, and Mr. Hall stated that it was not sufficient that merely the ground should be watered, but that the whole of the dust lodging anywhere should be damped. The evidence of the day overman, William Rees, on this matter seems to indicate that, in his opinion also, the watering generally was not sufficient. It is clear from the manager's evidence that, having given instructions only to fire shots between shifts, no precautions were taken, after the alteration in the Saturday night shift, that the terms of general rule 12, sub-rule 2 (2) of the Coal Mines Regulation Act, 1887, requiring all workmen, subject to the exceptions specified in the rule, to be removed from the seam where the shot is to be fired, were complied with.

T. Howells, 728-9.
R. Bumford, 740.
James Davies, 1057.
Thomas Owen, 1100.
J. R. Evans, 1119.
Edward Lewis, 1125.
G. Colwill, 1152.
Insufficient precautions as to watering when blasting.
H. T. Robson, 1564.
General watering as done here insufficient to prevent explosion travelling over the mine.
H. Hall, 1438.
Wm. Rees, 430-34.

The only explosives used in the mine for some time prior to the disaster were gelatine and gelignite (containing respectively 80 and 60 per cent. of explosive material), and no gunpowder was in use. But with regard to the custody and control of the explosives there was great carelessness. William Anstes, the chargeman, had the custody of them; he got "dynamite of different kinds and gelatine as well," as he said, from the magazine, which was above ground, and kept these explosives in the mine in a box on the Cilfynydd level, between the lamp station and the point marked B. The box was kept locked, with the key hung up at the end of it. Fuses and caps were kept in another box 3 yards away, and the key of this box was kept with that of the other. It was thus open to any one to unlock the box and help himself to explosives, and Anstes admitted to me that he had known men to take them from the box without coming to him for them. The reason he gave for leaving the key by the box, and not keeping it in his possession, was that he was afraid he would lose it.

Wm. Lewis, 984.
Explosives used in the mine. Great carelessness with regard to their custody.
Wm. Anstes, 909-10.
W. Lewis, 986.
W. Anstes, 912.
W. Anstes, 918.
Price Wilson, 935.

After the explosion, no less than 23 lbs. of explosive material were found in this box, none of it having been exploded. The only excuse given by Anstes for having this excessive quantity kept below, a clear infringement of general rule 12, sub-rule (*a*) of the Act of 1887, on the morning of the explosion, was that, in his own words, he had "four shifts in front of him" before he could get any more explosives, because of Sunday intervening; he knew it was wrong, but said this was the first time he had had this large amount in the box below. But inasmuch as he had "four shifts in front of him" every Saturday, his explanation is very unsatisfactory, and from his demeanour, and the way he gave his evidence, I am not inclined to believe it. Moreover, the last time he had taken a canister down prior to the explosion was a few days before, and then he only brought one 5 lb. canister, so that there must have been a considerable quantity stored in the box earlier in the

P. Jones, 259.
W. Anstes, 912.
Anstes, 915.
Anstes, 920.

Anstes, 921.

week. No blame, in my opinion, attaches to the storekeeper, who supplied Anstes from the magazine with one 5 lb. canister at a time, and no more. *See* general rule 12, sub-rule (*b*).

P. Jones, 259.
P. Jones, 1042.
W. Lewis, 985–6.

The manager did not know that this large quantity of explosive material was kept below, or that "Anstes had more than the law allowed him to carry," nor that the keys were kept by the box. The agent was also unaware of this, and added that he would stop it in the future.

Wm. Lewis, 986.

Some gunpowder was found in the magazine, and has been there for 11 or 12 years, but has not been used since they were sinking the pit. The above facts as to the storage of explosives below, and the ignorance of the manager and agent either of this or of the quantity taken from the store by Anstes, show, it is submitted, a deplorable recklessness and indifference on the part of the chargeman, and insufficient control by the management.

H. Lewis, 1271–2.

The managing director said that the quantity of explosives now used in the mine was much less than formerly; five years ago they used as much as 5,000 lbs., and now they use 1,000 lbs. in the year, and, he added, they "discourage blasting as much as possible."

Offences disclosed against general rule 12, sub-rules (a), (c), and (i).

I am of opinion, upon a review of this portion of the evidence, that it discloses offences against general rule 12, sub-rules (*a*) and (*i*).

Evidence showing indications of force in Grover's level, having regard to the theory of the inspectors.

2. *Indications of force in Grover's level, having regard to the theory of the inspectors that the explosion originated at the point A, and evidence as to the alleged blasting of timbers at that point.*

Wm. Garnett, 325–6, 333.

In Grover's level, in William Garnett's district (1*a* district, Grover's side), there was no blasting in rock, but only in timber, which was never fired except on Saturdays, and not necessarily—for this is the conclusion, in my opinion as stated above from the evidence on this point—in double partings only.

Timbers at point A.
Wm. Garnett, 327–9.
Wm. Rees, 424.

At the point A there were two pairs of timbers (*i.e.*, four "arms" and two "collars") 7 to 8 feet apart. Garnett stated that they were getting rotten, one (perhaps two or three) of the arms being broken, and a pair of new timbers had been placed by the repairer, under his supervision, a week or nine days before the explosion, on the side of each of the old pairs, and at a distance of about 18 inches from them. They were placed on the out-by and in-by side respectively of the old pairs, which were thus inside of and

Wm. Garnett, 329.

between the new ones. The old ones, Garnett said, were to be removed "by hatchet and bar," and not to be blasted. The day overman, William Rees,

Wm. Rees, 423-5.

stated that the "collars" were getting low, having "squeezed down," and the horses "roofed," or rubbed against them in passing. The length of the "collars" was about 7 feet, and the top there was clift and not rock.

Edward Rees, 475–76.
P. Jones, 116, 239.

William Rees instructed John Evans (the night overman) to have these old timbers removed; it was Evans' duty to see that the timbermen and repairers did the necessary work there.

James Smith, 942.

At a quarter before 2 on the afternoon of the explosion, James Smith, a timberman working in the day shift on Grover's side (district 1*a*), passed under these timbers on his way out, and noticed that "they were closed in by fresh timbers on each side." He did not notice any holes charged in the old timbers.

Noah Gould, 1167–73.

One of the witnesses called on behalf of the men, Noah Gould, said that as long ago as the Friday fortnight before the explosion he noticed that auger holes, for the purpose of blasting, had been bored in the collars of the two pairs of old timbers at this point, that after the explosion these particular timbers were under the fall there, and were put in a tram by him and taken to the pit, having been marked with chalk for identification. If this man's evidence could be relied on, it would be important, but I am of opinion that

J. M. Sims, 1631.

it cannot, and for the following reasons. On the Tuesday or Wednesday after the explosion, the rubbish caused by the fall at this point having been cleared away, certain timbers were shown to Mr. Sims, one of the assistant inspectors, by one of the officials of the mine. These timbers were pointed out to Mr. Sims as being the timbers that had been found under the fall,

J. M. Sims, 1631–2.
Fall at A caused by explosion, timbers found under fall

and they were placed on the side of the road. There were two collars and four arms, one collar was not broken, and therefore could not have been blasted; another collar had been cut in two by a hatchet, in clearing the fall

in Mr. Sims' opinion. Four arms were there, and he thinks all of them were broken; he did not notice any *decided* shot holes, and the only *one of these timbers that is suspicious, in his opinion, is one of the arms.* Now I have no reason to doubt that the timbers were found under or partly under the fall, although Mr. Sims was not present when they were discovered. If, consistently with the work of rescue and relief after the explosion, the clearing of this fall could have been delayed, or if Mr. Sims had been there when these timbers were found and moved, it would have been more satisfactory, for their identity with those shown to him is a matter of great importance. But in a disaster of such magnitude this was impossible, and I do not consider that by the clearing of the fall, the provisions of section 35 sub-section 2 of the Act of 1887 have in any way been infringed. This sub-section provides that "where loss of life or serious personal injury has immediately "resulted from an explosion or accident, the place where the explosion or "accident occurred, shall be left as it was immediately after the explosion or "accident," until the expiration of at least three days after the sending of the notice of the accident required by section 35 sub-section 1 (ii), "or "until the visit of the place by an inspector, whichever first happens, unless "compliance with this enactment would tend to increase a danger or would "impede the working of the mine." As the inspectors went down the mine immediately they had notice of the explosion, they had been there before the expiration of the three days mentioned in this sub-section, and those who cleared the fall at the point A were entitled to do so. Moreover, the words "the place where the explosion or accident occurred" in the above sub-section are difficult of application to a case like the present, where it was not clear in what place in the mine the explosion had occurred, and where its extent and that of the accident comprise in effect the whole of the colliery. In any case, then, there is no reason to doubt, and no evidence to rebut the statement that the timbers shown to Mr. Sims were those two pairs of old timbers at the point A. Of these one collar was unbroken and there was no hole bored in it, so that Noah Gould is clearly mistaken as to one of the collars he spoke to. But there is another reason for doubting the accuracy or trustworthiness of his evidence. He said to me in cross-examination that the word "pump" was written in chalk on the timbers at the time he removed them on the Wednesday after the explosion, whereas Mr. Sims only marked them in chalk in this way as late as Tuesday, July 27th, his mark upon them when they were shown him in the mine having been a broad arrow. There is therefore no evidence, worthy of acceptance, that these timbers at the point A had holes bored in them before the explosion, and it is therefore necessary to consider the statements of the witnesses of what they saw two or three hours *after* the explosion, between the point A and the double parting on Grover's level near Llanfabon dip. Garnett's evidence is as follows:—The body of Morris Ashton (acting as night fireman for the time, in place of Garnett who had been unwell) was found on the main level, *just outside the horse-pump dip.* William Roberts (the chargeman who did Anstes' work in the night shift) was found dead, near the "mouth," or top, of the horse-pump dip, on the level, but *just on the inside corner of the dip;* both were on the north side of the level, halfway between the sides and rails. The body of John Evans (night overman) was found *in the dip* 4 or 5 yards from that of William Roberts. These three bodies were only slightly burnt, and the deaths were due to suffocation from after-damp. Just below the horse-pump dip there was a fall, and the two pairs of old timbers at the point A, which, as stated above, James Smith had seen standing at a quarter to 2 that afternoon were down, partly in and partly out of the fall. [The new timbers by the side of the old ones were apparently still standing after the explosion.] On the level, within 2 yards of the timber, but just inside the fall, and about 30 yards from the horse-pump dip, was found the body of David Llewellyn, timberman, with his hatchet close by him, and a spade was there also; about two yards further inside lay across the road (their heads in the middle of the road) the bodies of William Jones, ripper, and Owen Hughes, ripper; no tools were found by them. The next body found was that of John Ashton, ripper, and was 40 yards further in, at the top of Llanfabon dip, and slightly burnt. Forty yards down this dip, as previously mentioned, were found the mutilated remains of Richard Owen

shown to inspector and marked by him for identification, six pieces marked. In his opinion only one of these timbers suspicious.
J. M. Sims, 1629.

J. M. Sims, 1628, 1630.

W. Garnett, 344-49.

Position of bodies found near the point A; men specially concerned with blasting found near each other, dea one with detonators in his pocket.
P. Jones, 67.
W. Garnett, 345.

Dr. Lyttle, 1587.

James Smith, 942.

Noah Gould, 1187.

Wm. Garnett, 368, 373.

Bodies of timberman and hauliers found inside the fall at A.
Evan Davies, 585.
Wm. Garnett, 349.

(haulier). There was a fall near the lamp station by Askett's heading. Some arms of timber here, at the point D., were still standing nearly upright, but the collars were under this fall. Also underneath the fall was part of one tram, and when the fall was cleared, *16 to 20 trams full of coal* were found there. This is Garnett's account of what he found between the points A and D.

W. Garnett, 352.

Now it is a strange thing that the three men whose duties were specially concerned with blasting, should have been found together in or near the horse-pump dip, at that time, unless they had been engaged in it. This conclusion is strengthened by the fact that William Roberts (the chargeman) was found with detonators (caps) in his pocket. Edward Rees (day fireman), who was present when a box or tin containing these caps was found on Roberts, said he could not tell whether it would be in Roberts' possession for blasting purposes or not, "as he might carry the box with him very often when he did not want it," and he has known him sometimes to do this. Even if this were true, and I do not believe it, it does not explain the presence of these three men together, and in that place, except for some reason connected with blasting.

Edward Rees, 478.

Edward Rees, 479.

Garnett, when asked by me to account for this, said they might have been there "for consultation," for he found no tools of any kind near them. He could give no other reason; but admitted that he himself, as night fireman, had never been in the horse-pump dip "for consultation," and that if there had been blasting near the timbers at point A, the horse-pump dip would be the natural place for these men to go to, after the shots had been fired. As the position of the bodies found in or near to the horse-pump dip is of considerable importance in connexion with the question whether there was any blasting in timber at the point A, it is necessary to refer briefly to the other witnesses whose evidence dealt with this point. Evan Davies (collier) said that the bodies of William Roberts and Morris Ashton were more in the horse-pump dip than on the level; David Llewellyn's body was 3 or 4 yards on the inside of the fall—the fall, he said, was small, not more than would fill six or seven trams—*and near a manhole*, which was not further from the fall than 5 or 6 yards, and his body, and those of the two rippers, were *between the manhole and the fall.*

Wm. Garnett, 367, 373–4.

W. Garnett, 384.

Evan Davies, 589.

Evan Davies, 584–5.

Evan Davies, 588.

Manhole near the fall at A.

Job Jones, 1196–7.

The evidence of Job Jones (timberman), called on behalf of the men, was that these three bodies lay *opposite, and with their feet towards the manhole*, and that there was as much as 8 yards between the manhole and the fall.

Wm. Garnett, 1315.

Garnett was recalled to give evidence as to the manhole, and said that Llewellyn's body was *not opposite, but 2 yards outside the manhole.* The importance of determining, if possible, the position of these bodies with reference to the manhole is this: the contention made on behalf of the owners was that no blasting could have taken place at point A, because, among other reasons, these three men would not have taken refuge in a manhole as near as 5 yards to the place blasted, and further that the position of the bodies showed that they had not sought protection in the manhole. The chargeman, Anstes, said, however, that when a shot is fired, and no manhole is near, they generally go a distance of 50 or 60 yards for shelter; *but that a manhole within 8 yards would be safe*, though not, he added, within 5 yards. In this he is confirmed by Bumford, one of the two survivors. In Mr. Hall's opinion it is not unreasonable to take shelter in a manhole within 8 yards, and he thinks it very likely that these men went to the one here in question; and the conclusion that I draw from this portion of the evidence, regarding the manhole and the position of the bodies with reference to it, is that it is not, in itself, sufficient to refute the inspector's theory as to blasting at point A. I would add that the fact that a hatchet was found by the body of Llewellyn does not by any means prove that the timber was to be cut out and not blasted; because at the point C, as previously mentioned, where timbers were undoubtedly blasted that day and a large fall took place, hatchets were found by the bodies of the hauliers and timbermen.

P. Jones, 240–1, 249.
Wm. Garnett, 367, 408.
Evan Davies, 590.
Wm. Anstes, 932–8.

R. Bumford, 750.
H. Hall, 1452.

Morgan Dyer, 666.
Robert Phillips, 1189–91.

A haulier, Robert Phillips, saw John Evans, the night overman, as late as 25 or 20 minutes to 4, accompanied by another man; *they were running*, and out of breath, from the Cilfynydd side to Grover's side. Phillips was waiting at the bottom of the pit for the cage to take him up, and it was there that

these two men passed him. He did not recognise the man with Evans, but it was not William Roberts, the chargeman.

I have previously referred to the timbers at point D, which had been charged, but not fired, before the explosion. These shots were charged at 1.30 p.m. on that Saturday by Price Wilson, who was acting as chargeman on Grover's side; and as they were being charged, the day fireman, Edward Rees, passed, and noticed the *trams full of coals*, mentioned above, at the double parting, *close to the timbers*. These trams could not be hauled to the pit, because the clutch of the Grover engine failed to act at about 1 o'clock on that day, and it was for this reason that the "journey" of full trams was standing there. At 10 minutes to 2, William Rees, the day overman, *told John Evans of this accident to the engine, and that therefore the blasting of the timbers at point D could not be proceeded with;* otherwise the rubbish would have come down upon the trams full of coal. Now it is contended, on behalf of the owners, that if John Evans had clear instructions, before going down the mine, not to blast at point D, he would not blast at point A, as that would cause a fall on the level, and prevent this "journey," or train of trams, full of coal, from being hauled to the pit. Moreover, repairers and fitters were sent down the pit a few minutes before the explosion, and their tools for repairing the engine were placed in the cage just before it happened. Now there was no evidence that John Evans knew, or was told, whether or not the engine would be repaired that evening, although the fact of, and reasons for his being instructed not to blast at D, ought to have been sufficient for no blasting at all to be done between the full "journey" of coals and the shaft. The contention, therefore, while not without force, is not in itself sufficient to disprove or meet the allegation that the timbers at point A were blasted.

Price Wilson, 935.

Wm. Rees, 451.

Wm. Howell, 951.
James Graves, 780.

I have already referred to the timbers shown to Mr. Sims as having been found under the fall at point A, and marked by him for identification, and to his statement that he found no decided shot-holes in them, but that one arm was, in his opinion, "suspicious." This arm, which was black and charred, was shown to several of the witnesses. The day overman (William Rees) thought that its appearance indicated that it had not been blasted. Garnett (night fireman) was not so sure, but thought the coal dust on it could have penetrated through the cracks, and was not caused by blasting. Anstes (chargeman) said it had not the appearance of having been either bored or blasted, and that it was too rotten for boring. These three men have had experience of and seen timbers that have been blasted. The manager and under manager were also of opinion that this arm had not been blasted. Their opinion would have been of more value if they had ever seen timber blasted, and, as mentioned above, they never have.

Wm. Rees, 442–3.

Wm. Garnett, 392–4.

W. Anstes, 926–7.

P. Jones, 304.
Wm. Jones 831–3.

Now it must be admitted that this "suspicion" (of having been blasted) attaching only to one arm, is not itself conclusive, though if blasting had been going on, the fact that one piece of timber, and not six, had been fired, would not be really material, if it could be shown otherwise, or if there was a strong inference that the explosion originated there. Mr. Robson is of opinion that there has been blasting at the point A, and this opinion is formed "from the position of the bodies and the condition of the place," and not alone from the appearance of this piece of timber. I would here refer to the report upon this explosion by Professor Dixon, dated 6th July 1894, that is before this inquiry, and ordered by the House of Commons to be printed on the 14th August 1894. Referring to this piece of timber, Professor Dixon says, "Near the extremity of one of the 'arms' from the first fall (*i.e.*, the "point A), the wood was splintered and certain marks were observed on it. "Either the arm had been splintered by the fall or by the explosion of "a cartridge in it. I had several dynamite shots fired in similar baulks of "wood, and in every case part of the hole was left, widened and split, but "showing the marks of the auger. On comparing the marks with those on "the arm from the first fall, *I am strongly of opinion that a dynamite shot had "been fired in the latter and that this was the origin of the explosion.*" Such evidence, from an authority like Professor Dixon, would have been of great value at this inquiry, and had I known of his report, I would have suggested that he should be called as a witness.

J. T. Robson, 1579.

Mr. Robson is of opinion that there has been blasting at point A.

Report of Professor Dixon dated 6th July 1894. His opinion that one of the timbers at A has been blasted.

I would now refer to the indications showing the *direction* of the force in Grover's level, having regard to the inspector's theory that the cause of the

Indications showing direction of the force in Grover's level, between Dudson's heading and point A show force in both directions, inwards and outwards.

explosion was the blasting of timber at point A. Between Dudson's heading and the horse-pump dip the indications point to the blast going in both directions inwards and outwards. There are not many indications either way along this distance of the level, but it will be convenient to state them in order, such as they are.

P. Jones, 118, 120.
Wm. Lewis, 981.

Manholes.—Some of the manholes have been blown in both directions, sometimes the inner and sometimes the outer buttress having fallen. The manager said that there had been some heavy falls on the top of the manholes, and much would depend on the way in and the direction from which these falls came. The managing director considers that the direction of force, as shown by the manholes, is inwards, because where the out-by pier was knocked down, the stones were found in the manhole, and where the in-by pier had fallen the stones were on the in-by side. Mr. Treharne Rees, a mining engineer, and one of the witnesses called on behalf of the owners, was of the same opinion ; the inspectors however, were not.

H. Lewis, 1211.

Treharne Rees, 1417–8.

Timbers blown in both directions.
P. Jones, 140, 141, 188.
Wm. Garnett, 405.
Wm. Rees, 456.

Timbers.—These are blown in both directions. Some witnesses thought that they were mostly blown inwards. On the evening of the second day of the inquiry I went down the mine and had the timbers on this portion of the level pointed out to me by inspectors Martin and Sims, and came to the conclusion that more were blown *outwards* than inwards.

Other indications.
R. Jones, 123.
Wm. Garnett, 405–6.
P. Jones, 97, 98.
D. Hannah.

A horse was blown against the *inside* corner of the road leading to the small stable on Grover's level.

Two beams on the in-by side of the Grover engine-house were blown *outwards.*

There were four beams under the Grover engine-house, supporting the engine. The first beam, on the side towards the shaft, has been lifted by the force of the explosion and has apparently been raised by a force coming *from* the pit, because the three other beams are not disturbed.

P. Jones, 96.
H. Lewis, 1209.

P. Jones, 302.
H. Lewis, 1271.

A sheaf or pulley under one of the beams above mentioned, and attached by two arms, has been blown *inwards.*

Wm. Jones, 938–9.

The body of the fitter in the Grover engine-house was found by his father, who gave evidence as to the finding, on the shaft of the reversing lever, in a position indicating that he had been thrown in a direction *inwards* from the shaft.

J. Cavalry, 955–63.

An iron signal knocker, weighing nearly 1 cwt., on the north side of Grover's level, opposite Dudson's heading, was, according to one witness, blown *inwards* for about 8 or 10 yards ; but according to another witness it was blown *outwards* 10 or 12 yards, towards the shaft.

Job Jones, 1195.

P. Jones. 100.
Wm. Lewis, 979.

Another signal knocker, at the bottom of but in Dudson's heading and not on the level, was blown up the heading. The manager and agent regard this indication as showing force inwards from the shaft ; the inspectors, as showing force outwards towards the shaft.

P. Jones, 131–3.

The masonry work of the boilers on Grover's side is blown *from the intake* towards the return, whereas that of the boilers on the Gilfynydd side is blown *from the return* to the intake. This indicates a force outwards, towards the shaft.

The above are the only indications of force in Grover's level between the pit and the point A. Between the latter point and the top of Llanfabon dip there are no other indications of force than those previously mentioned, and it is admitted that from Llanfabon dip the direction of the force is altogether inwards. It thus appears that Grover's level, for a distance of at least 400 yards from the point A. outwards, shows few if complex indications of force. On both sides of this distance the indications are more severe.

Directions of force in Cilfynydd level from the point B to the shaft mostly outwards.

3. *Direction of force in the Cilfynydd level from the point B to the shaft; evidence in support of the theory of the owners that the initial source of the explosion was at the point B.*

The indications of force here are the following :—

Wm. Davies, 630.
Wm. Lewis, 974.

A post with a sheaf or pulley attached was blown *outwards ;* this post was 6 yards from the separation doors leading to the returns.

In the Cilfynydd engine-house, a signal knocker was blown *outwards;* part of the staging was blown *outwards*, and one board was blown back against the grease-cock on the steam-chest, indicating force *outwards;* a strap for holding the catches was bent towards the face, indicating force *inwards;* the stage of the engine was burning.

Wm. Davies, 628–9. Wm. Lewis, 976. Morgan Dyer, 671. P. Jones, 137. Wm. Lewis, 975. Wm. Davies, 629.

The engineer was blown 4 or 5 yards *outwards* from the engine-house, and his clothes were burning.

P. Jones, 86, 93, 136. Wm. Davies, 637. Wm. Garnett, 381. M. Dyer, 671.

Three sheaves or pulleys holding the tail rope were *bent two outwards* towards the pit, and *one inwards*. The managing director thought that the one blown inwards was a loose pulley, and would swing, and thus endeavoured to explain the direction in which it was bent.

P. Jones, 86–7, 92–3, 136. Wm. Davies, 636. James Graves, 776. Wm. Garnett, 381. P. Jones, 121–2. M. Dyer, 671. Wm. Davies, 630–1, 637.

A "journey" of 12 or 15 trams on the pit parting *was blown in both directions.*

H. Lewis, 1222. Wm. Davies, 630, 638. Morgan Dyer, 670.

The body of a man was found on the Cilfynydd side of the shaft, blown against the wall on the out-by side, indicating force outwards.

Wm. Rees, 459. Wm. Lewis, 971.

A horse and two trams were blown *outwards* from the Cilfynydd side into the "sump," or bottom of the shaft.

James Graves, 778, 784–5. Wm. Garnett, 403. Wm. Rees, 459.

The rope-smith's tools, which were kept in a box in the engine-house on the Cilfynydd side, were found in the "sump," showing force *outwards.*

James Graves, 782. Wm. Garnett, 381.

There is also evidence of force outwards from the position of a tram and rubbish in the cage. Just before the explosion happened, the banksman lowered a tram containing tools for the repairers and fitters. This was on that portion of the cage nearest the Cilfynydd side. Before any attempt to descend, after the explosion, could be made, this cage was brought up, and it was then found that the tram had been *shifted over the "scotch"* (a piece of iron in the cage, worked with a pivot, and a contrivance for keeping the tram steady) *to the other* (or Grover) *side of the cage; and that part of the cage near to the Cilfynydd side was found to be filled with rubbish.* This would show a strong force *outwards*, towards the pit from the Cilfynydd side.

James Graves, 780. Wm. Howell, 952. Wm. Lewis, 971.

To the above indications of force I would add that in the Cilfynydd *return*, near the bottom of the Bodwenarth incline, the body of a tram was found about 15 yards *outwards in the return* from the wheels, and must have been forced in this direction by the blast.

P. Jones, 130. Wm. Lewis, 977. Morgan Dyer, 676.

I have already mentioned that the masonry of the boilers on the Cilfynydd side was blown *from the return to the intake*, indicating that the force was *inwards* there; the managing director endeavoured to explain this as being really an indication of force outwards from the point B, by saying that the blast went first along the intake, and coming *afterwards* to the return, caused this masonry to be blown from that direction towards the intake.

H. Lewis, 1253.

The above summary of the indications as to the direction of the force between the point B and the shaft, shows that, although there is some complexity, traces of the blast being in both directions, *there is a preponderance of evidence that the direction of the force was outwards.*

The fall at the point B, at which point according to the theory of the owners, the explosion must have originated, was about 24 yards in length; 13 yards of this was in the pit pillar, the remaining 11 yards being in the old workings marked pink on the plan. The roof is of solid rock, and a tracing of the section of the Cilfynydd level, showing the dimensions and extent of this fall, was produced. A copy of the tracing is sent with this report. The cavity caused by the fall was in part as high as 15 feet above the level. *There was no trace of gas in this cavity after the explosion.* At a height of about $4\frac{1}{2}$ feet above the road, 7 or 8 "comets" (naked lights) were hung along the level between the Cilfynydd engine-house and the lamp station at the top of Pantddu dip. One of these comets was inside the point B, and all the others were between that point and the shaft. They were equally distributed along this distance, so that some were under the fall and others between that and the shaft. The theory that the initial source of the explosion was at the point B seems to have been propounded because, in the opinion of those who gave evidence in its support, it would account for those indications of force

Fall of rock top at the point B, theory of owners that outburst of gas here was original cause of explosion.

Wm. Lewis, 982.

Tracing of the section of the level, showing the dimensions and extent of the fall.

P. Jones, 179. Wm. Lewis, 1011. Wm. Davies, 639. H. Watkins, 714–15. P. Jones, 184. Wm. Lewis, 983.

No trace of gas in the cavity caused by this fall after the explosion.

P. Jones, 170.

H. Lewis, 1212.
H. Bramwell, 1394.

outwards towards the pit which have been enumerated above, and also for the inward direction of the blast on the in-by side of the point B.

D. Hannah, 1357.
H. Kirkhouse, 1402.
D. Hannah, 1351.
H. Kirkhouse, 1402.

None of the four witnesses called on this particular point—they were all mining engineers with a long experience—were able to give a single recorded instance of such a sudden fall, without any premonitory sign, having ever taken place in a rock top of this description and so near the shaft, or to name any mine where it had occurred. They admitted that if this theory be correct, a disaster as terrible as the one at this colliery might occur at any time without warning, and in spite of every precaution imposed by law or suggested by experience. Moreover, the possibility that their opinion is well founded, and that an outburst of gas at this point was ignited by the comets, would in itself be a matter of grave anxiety, inasmuch as the use of naked lights along this portion of the mine was not illegal [*see* general rule 8, sub-rule (*a*)], and would seem to render necessary a change in the law, absolutely prohibiting naked lights in any part of a colliery; otherwise a repetition of such a disaster as this might happen in any dry and dusty mine.

H. Lewis, 1217–18.

A sudden fall in the Rhondda Merthyr Colliery, that occurred about 20 years ago, was mentioned by the managing director as supporting this theory. He said that about 100 tons of rock broke down very suddenly there, and caused a discharge of a large volume of gas. But this proved not to be a case in point at all, for, from the cross-examination of William Rowlands, who many years ago, was overman there, and remembered this fall, and was recalled to speak to it, *the rock top there had shown signs of "squeezing" and pressing down the timbers*, which had to be removed; whereas in the present case, there were absolutely no indications that the rock top was giving way. Now, it naturally suggests itself that this fall, coming down with such suddenness at the point B, would extinguish the comets before the gas could reach them. But there were several comets *outside* the fall, and it might be one of these that caused the explosion. When cross-examined whether the fall would not put out the lights before the gas could reach them, the agent gave it as his opinion that the gas would be ignited by the comets first. Whether this is or is not correct, it is not, in my opinion, a refutation of, or an answer to the theory to say that the fall *must* have extinguished the comets, because the gas *might* have ignited some of those outside it. I have already mentioned that 117,000 cubic feet of air per minute passed the point B, rendering an explosion at that point, from the cause suggested, all the more improbable. Indeed, one of the experts called in support of this theory, Mr. Bramwell, agent for the Great Western Colliery, thought it *possible but not probable* that the explosion was caused by an outburst of gas from that fall, which, in the opinion of the inspectors, was merely the result of the explosion at point *A*.

Wm. Rowlands, 1336–8.

The fall at B need not necessarily extinguish the comets, some of which were outside it.

H. Lewis, 1298.

Wm. Lewis, 983–4.

Wm. Lewis, 984.

117,000 *cubic feet of air per minute passed the point B.*

H. Bramwell, 1394. *Improbability of the owners' theory admitted by Mr. Bramwell.*

Effects of the explosion noticed at the top of the shaft relied on by owners in support of their theory. Inspectors consider that this evidence neither affects nor refutes their theory, nor that of the owners.

W. J. Howells, 947.
John Clifton, 1348–9.
Dr. Lyttle, 1592.

R. Phillips, 1190–1.
James Graves, 775–7.

Wm. Rees, 456.

The effects of the explosion noticed *at the top of the shaft*, disclosed by the evidence, are also relied upon by the owners, as showing that the origin of the explosion was at the point B. The banksman, W. J. Howells, said that he heard a loud report from the *downcast* pit, and was blown a few yards away; there was a tremendous quantity of dust, which he has no doubt was coal dust. The assistant banksman confirms this. Dr. Lyttle, however, whose house is about 200 yards from the pit, heard *two loud reports* and saw a column of smoke from the *upcast*, which at once spread out over both shafts to a height higher than the sheaves and gear over the downcast, and he saw no smoke from the downcast pit. Dr. Lyttle's evidence is confirmed by Robert Phillips, haulier. Graves, the pitman, saw the planking over the downcast pit hurled into the air, and heard *two loud reports* in quick succession, and saw a volume of smoke come up the upcast; but noticed no flame, nor any smoke from the downcast. This is confirmed by William Rees, the day overman. Taking Dr. Lyttle's account as correct, the contention made against the inspectors' theory is that if the explosion originated at the point A, *the smoke and dust would have gone up the downcast pit*, and that the fact that they went up the *upcast* shows that the explosion must have originated on the Cilfynydd side. This evidence of the effects of the explosion noticed on the top of the shaft, does not, in the opinion of the inspectors, affect or refute either their theory or that of the owners.

Evidence of the two survivors that the flame was blue; this indicates fire-damp.

I would now refer to the important evidence given by the two survivors, Thomas Howells and Richard Bumford, as to the *colour of the flame they saw*, and thus upon the question whether this was exclusively a coal-dust explosion, or

one originally caused by gas. Thomas Howells said that he was working in Curly's level, Bodwenarth district, when his lamp went out, and he came down the incline towards the lamp station on Cilfynydd level, which he reached, and where he was found after the explosion. He saw a *blue flame;* he says, "I saw it sufficient to blind me," and remembers nothing more. Bumford, the other survivor, who was working in Mordecai's level, Pantddu district, heard *two sounds like two claps of thunder*, the level became filled with dust, and all the lamps went out. *Through the dust he thinks he saw a flame that was rather blue in colour*, going along the top, above their heads as they stood up. He cannot remember anything more except that he flung away his lamp, and with the other men, all of whom succumbed to the after-damp, went into Pantddu dip. The flame did not burn him, but passed him with the dust, and he saw neither flame nor dust afterwards. Now it seems clear that the *flame from fire-damp is blue*, whereas that from coal dust, in a state of high combustion, is orange. This evidence, therefore, indicates that the blue flame passing the lamp station at the top of the Pantddu dip, and seen down the dip by Mordecai's level, was caused by fire-damp, and, as already stated, Pantddu dip is the wettest portion of the mine, where there was hardly any coal dust.

T. Howells, 721–33.

T. Howells, 727.

R. Bumford, 742.

R. Bumford, 743.

H. Hall, 1479.

It is upon the above evidence that the owners rely in support of their theory that the initial source of the explosion was at the point B.

4. *Conclusion as to the cause of the Explosion and other Questions arising on the Evidence.*

Can these complex and diverse indications of force be reconciled with the theory of the inspectors?

The necessity then arises of reconciling the complex and diverse indications of force above enumerated and the blue colour of the flame seen by the survivors, with the theory that the initial source of the explosion is to be placed as the inspectors place it, at the point A. While admitting that the result of the explosion, meaning that the colliery would have been devastated in the same manner and to the same extent, would not have been different if its origin could be placed at the point B, Mr. Hall is still of opinion that it commenced at the point A. His view is that the flame produced by the blasting at the point A, *ignited some accumulation of gas over the timbers there*, and that this in turn set fire to the coal dust. In other words, that there was *no direct communication of flame to the coal dust* from blasting.

H. Hall, 1537.

Inspectors still maintain that their theory is correct, but they regard it as, initially, an explosion of gas caused by the blasting at A.

Inspectors' theory again stated.

Mr. Robson has "no reasonable doubt" that the explosion originated at the point A, and that probably there was gas in the roof above the timbers and that *the flame from the shot ignited "a mixture of gas and coal dust."*

H. Hall, 1434–5.

J. T. Robson, 1563–4, 1566.

The other inspectors agree with the opinions, which were arrived at quite independently, of Mr. Robson and Mr. Hall. I have come to the conclusion that the theory of the owners, upon the evidence examined above, cannot be accepted as correct. Apart from the indications of force outwards from the point B, there is nothing in the evidence that really illustrates or confirms it, and it must be admitted, for the reasons mentioned above, that but for these indications its probability is very remote. But it is just these indications that require to be explained, if the inspectors are right in placing the origin of the explosion at the point A. Mr. Hall accounts for them thus; he says, "I think every sign, as far as I can judge on that ground, between the shaft "and the separation doors shows that *the blast passed over the ground twice*, "and I have no doubt but what it did," meaning that the force proceeding from Grover's side went through the return, and thence back again into the Cilfynydd level, producing these indications of force outwards from the point B; and the other inspectors agree with this explanation. Now I am satisfied that all the evidence available or relevant, in connection with questions of *fact*, was tendered and heard at this inquiry, and nevertheless the jury were unable to agree where to place the source of the explosion, the majority, however, it is stated, accepting the view of the inspectors. The matter is indeed entirely one of *inference* from the evidence, and is really for experts. Professor Dixon in his report, already alluded to, deals with this very point, and says, "the marks of violence *towards* the shaft, found "near the entrance to the south-east (*i.e.*, Cilfynydd) level are either due to a "wave of air propagated backwards when the explosion had again gathered "strength, or to one of those oscillations of the flame which are seen in

J. T. Robson, 1593.

Owners' theory cannot, in my opinion, be accepted as correct.

H. Hall, 1526.

Mr. Hall's explanation of the complex indications; blast passed over the ground twice.

All evidence available or relevant upon questions of fact *heard at this inquiry. The matter is now solely one of inference, and really for experts.*

Reference to Professor Dixon's report, and his explanation of the complex indications.

" laboratory experiments, and whose effects have often been observed in " mines." While, upon the whole of the evidence as to what was seen on Grover's level on that Saturday evening, I feel bound to come to the conclusion that the theory of the inspectors is right, the indications of force outwards from the point B, and the other evidence relied upon by the owners, are, in my opinion, in the absence of the clearest scientific explanation by experts, sufficient to render doubtful its unqualified acceptance by a jury. But to leave a matter of such gravity in doubt, where, moreover, if the theory put forward by the owners remains unrefuted, legislation prohibiting the use of naked lights *anywhere* in a mine would seem necessary, should, it is respectfully submitted, be avoided if at all possible. I do not feel justified in relying on the opinion of Professor Dixon for the purpose of this report, because it was given before and independently of this inquiry. I therefore venture to suggest that the evidence given at the inquiry, as analysed in this report, should be put before him and other scientific men familiar with the subject, and if they are clearly of opinion (*a*) that this evidence, and particularly that portion of it showing force outwards from the point B, is consistent with the theory of the inspectors; (*b*) that notwithstanding, and in spite of this evidence, the theory of the owners cannot possibly be accepted—then I should feel justified in advising that the burden of proving the inspectors' theory correct, and that the deaths were caused through negligence in allowing blasting during shifts, might be undertaken before a jury on a prosecution for manslaughter. In the absence of such an opinion from experts of high authority, I cannot advise that this course should be adopted, having regard to the complex and contradictory indications disclosed by the evidence as it now stands.

In my opinion, theory of inspectors right, but in the absence of the clearest scientific explanation of the complex indications referred to, it is doubtful whether a jury would accept it.

Suggestion that the evidence should be submitted to experts of high authority.

If such experts come to a certain conclusion, but not otherwise, *then, in my opinion, negligence in allowing blasting during shifts could be shown to have caused the disaster.*

Other questions arising on the evidence.

There are certain other questions arising on the evidence to which I would now briefly refer. Having regard to the opinion of the inspectors that the explosion was in the first instance caused by gas, and not by the direct ignition of coal dust, the question whether coal dust can be fired directly from explosives like gelatine and gelignite does not, perhaps, directly arise. But indirectly it does, and for this reason; Mr. Hall's report for the year 1893, to the Secretary of State (published on 26th May 1894), mentions, at page 12, that certain "high explosives" are incapable of igniting or exploding coal dust, *e.g.*, roburite and ammonite were fired by him in the course of his experiments without effect; but as soon as gunpowder was introduced its explosion was followed by violent dust explosions. This statement was relied upon, on behalf of the owners of the mine, as showing that whatever caused the disaster, it was not a *direct* ignition of coal dust by gelatine and gelignite. But this conclusion does not at all follow when Mr. Hall's report above alluded to, and also his report to the Royal Commission on Explosions from Coal Dust in Mines, are carefully examined. In his experiments made by means of a wrought-iron cannon, *the tamping occupied a space of 12 inches;* whereas in the blasting of timber in this mine, there was no real tamping at all. Now neither gelatine nor gelignite are flameless explosives; this was admitted by the agent, who added that properly tamped they would be nearly flameless. It thus follows that in the absence of tamping they would in all probability ignite coal dust. Indeed Mr. Hall said that gelatine gives off a considerable flame, nearly as much as gunpowder. The best explosives, in his opinion, from this point of view, are ammonite and roburite, used, of course, with proper tamping.

Wm. Lewis, 994.

H. Hall, 1543.

There is, as already mentioned, nothing in the Coal Mines Regulation Act, 1887, that in terms prohibits blasting in timber, and the application of section 42 of the Act, providing for arbitration, in the event of the owner, agent, or manager of a mine objecting to carry out the requisitions of an inspector, is not and cannot be made effective, in my opinion, for the purpose of preventing such blasting, because the inspector need not, as was unfortunately the case here, necessarily know or have been informed that such a practice exists in any mine. Moreover, the recommendations of the Royal Commission on Explosions from Coal Dust in Mines, in their recently published report do not specifically refer to, and were probably not intended to include, blasting in timber, which, as the evidence at this inquiry shows, from the impracticability of proper tamping, must inevitably be a source

See especially p. xxvii. of this Report. [C.—7401. 1894.]

of danger. It is, therefore, respectfully submitted that it ought to be prohibited by law.

Submission that blasting in timber should be prohibited by law.

The under manager, William Jones, admitted that since his appointment, three months before the explosion, he never went down the mine while the night shift was working, but said that he was on the top of the shaft every night before the men of that shift went below. Now rule 42 of the special rules of this colliery prescribes that the under manager must see that every officer under him and every other person employed at the colliery understands and fulfils his duty. In Mr. Robson's opinion the presence of the under manager during the night shift is more necessary than during the day. I agree with the finding of the jury on this point, that the under manager neglected his duty in not seeing that his subordinates in the night shift performed their duties in accordance with the rules.

Wm. Jones, 821.

Under manager never went down the mine while the night-shift was working. Special rule 42.

J. T. Robson, 1569, 1599–1600.

Then as to the "comets" or naked lights, and also as to the boilers being below, Mr. Robson stated that he disapproved of both. Their presence constitutes an added source of danger in a fiery mine, and though not illegal (cp., as to naked lights general rule 8 of the Act of 1887), he would advocate their exclusion.

J. T. Robson, 1563.

Mr. Robson disapproves of comets and of boilers below.

The evidence of inspections of the mine on behalf of the men under general rule 38 was very unsatisfactory. Such inspections were rare and perfunctory; there were none made from the 6th October 1893 to the 29th May 1894. The report of the inspection on the latter date, it lasted from about 7.30 in the morning until 3 in the afternoon, stated that the old workings were "clear of gas and well packed." It was admitted, however, by Levi Rees and William Thomas, who acted as examiners on behalf of the men, that they found gas on the 29th May. A "blower" of gas was found in Dan's heading, and sheets were put up, and the gas "cleared" in this way by means of ventilation; and their excuse for not reporting the gas was that it was the practice for the men's examiners only to report such accumulations of gas as they could not clear. William Thomas admitted that they were supposed to inspect every month or two months, but only do so three or four times in the year. He said that he reported the gas found by him on May 29th verbally to the men's committee, and did not think it serious, or he would have entered it in his report.

Inspection of mine on behalf of the men rare and perfunctory, and of very little use.

Levi Rees, 871–2, 880.

Wm. Thomas, 898.

Levi Rees, 878.

Wm. Thomas, 889–95.

L. Rees, 883.

Wm. Thomas, 895.

Wm. Thomas, 894.

Within the scope of these inspections on behalf of the men comes also the proper stowing or filling up of old workings. The men's examiners said they did not know whether there were any old places not filled up, and never pulled down the wall built at the entrance to an old working to see if it was properly packed, and filled with rubbish, or only "bashed," *i.e.*, with a cavity left inside, where gas might accumulate. Bumford, one of the survivors, said he had seen "bashing" done in a stall in Taylor's heading (David Thomas' level), and thought this was done *to conceal the gas* before the examiners came round. Again, Thomas Smith, one of the witnesses called on behalf of the men, said that on the occasion of the men's inspection on the 29th May last, he saw gas in one of the stalls off Dan Rees' level (Cilfynydd side); it was in a small hole at the top of the gob. He said he was told by Henry Watkins, the fireman, *to raise a wall across the end of the stall, i.e.*, bashing it, or leaving a cavity inside this wall, where the gas had accumulated, instead of properly filling it up. This work of "bashing" was began at 7 in the morning and was finished between 10 and 11, when the men's examiners arrived at the place, and they could not have seen whether the stall had been properly stowed or not. Watkins was recalled and denied Smith's story, that the bashing had been done by his instructions, saying that he had trusted him to do the work properly; but he admitted that there was a cavity there of 6 feet in length. With regard to the statements of Bumford and Smith that *bashing* had been done, these men (in so far as general rule 1 applies to bashing) have rendered themselves liable under special rule 274 for not reporting this breach of the Act to the manager or under manager. I do not, however, think that the instance they spoke to is a sufficiently clear breach of the provisions of general rule 1, which prescribes that an adequate amount of ventilation shall dilute and render harmless any gas, &c., as to make their omission to report it the

"Bashing" or improper stowing and filling up of old workings.

L. Rees, 877.

W. Thomas, 904.

R. Bumford, 766–7.

Thos. Smith, 1135–45.

H. Watkins, 1299.

subject of a prosecution. Moreover, as the provisions of general rule 38 with regard to the periodical inspections on behalf of the men are enabling and not compulsory, the fact that these inspections were neither sufficiently thorough nor frequent to be of any real or substantial use, would not create an offence against the Act. I agree with the finding of the jury, that upon the evidence these inspections were clearly of very little value. Numerous other instances of bashing, or improper stowing and packing of old workings, were alleged in the course of the inquiry; and the proceedings were adjourned from Friday evening, July 20th, to the following Tuesday morning, to enable the inspectors to examine those places, and the cavities in them, which had been disclosed since and in consequence of the explosion. As the result of this inspection, Mr. Robson said that although he took exception to the way in which some of the old working places were stowed, and that one or two places had been "bashed," in his opinion it had nothing to do with the cause of the explosion. The question as above stated seems to depend on the construction of general rule 1 (*cp.*, also special rule 63); and provided the ventilation is adequate to dilute or render harmless any gas, as prescribed by this general rule, there is apparently no obligation imposed to stow and fill up every disused stall, but, as Mr. Robson said, "it is good mining to do so."

J. T. Robson, 1556–60.

J. T. Robson, 1564.

J. T. Robson, 1559.

Firemen do not always report gas found before the commencement of each shift, in accordance with general rule 4 and special rule 69.

It appeared from the evidence of the firemen that they do not always report gas when they discover it on their inspection *before the commencement of each shift*, in accordance with general rule 4. The practice was only to report gas after the *first* inspection, *i.e.*, before the morning shift, but not if gas was found subsequently and cleared. Some even do not report it when found on the first inspection, if they can clear it. Special rule 69 prescribes that the inspection required by the fourth general rule, shall be made within two hours and a half *before the commencement of each shift;* and the fireman shall, *after each inspection*, report any accumulation or blower of gas, and also report where gas, if any, indicated by the condition of the flame of the lamp, and not diluted and rendered harmless in accordance with general rule 1, was found present in the mine.

D. Evans, 1052.

H. Watkins, 1299, 1300.
Edward Rees, 1322–28.

H. Lewis, 1288.

According to the managing director, the system throughout South Wales is that a fireman simply reports in his book what gas he finds in making his rounds before the men come in. If he were to find gas in the daytime, or at any time after his visit to the faces, he would not report it if "cleared." He thought it would be better that the firemen should report it. I am of opinion that it is rendered incumbent on the firemen, by virtue of special rule 69, to report any accumulation or blower of gas, whether cleared or not, and whether found on the first inspection or on the later one, and that an omission to do this has rendered them liable to prosecution for an offence against the Act of 1887. (*See* section 51, sub-section 3 of the Act.) It is then clear, from the evidence, that this was the general practice of the firemen, and it is submitted that the provisions of special rule 69 ought to be strictly complied with.

H. Lewis, 1288–9.

Question of negligence, and of offences against the Act of 1887.

5. *The Question of Negligence, and of Offences against the Coal Mines Regulation Act*, 1887.

There are, upon the evidence, in my opinion, two, and only two, possible charges of negligence that could be said or suggested to have caused the deaths in this disaster. The first is the blasting of timber *during* shifts on Saturdays; the second, the insufficient watering of the mine, owing to its dry and dusty nature, whereby the explosion was enabled to travel over and devastate practically the whole of it. I have already dealt with the first suggestion of negligence, and said that, while agreeing with the opinion of the inspectors that blasting timber at the point A caused this explosion, in the absence of the clearest scientific confirmation by experts that the indications of force outwards from the point B are consistent with this theory, and that, in spite of these indications, the theory of the owners cannot possibly be accepted, I cannot advise a prosecution for manslaughter. With regard to the second possible instance of negligence causing death, the insufficient watering of the mine generally, and the consequent ravages of the explosion, I am

clearly of opinion that the evidence upon this point is not strong enough to justify criminal proceedings. The system of watering was about to be improved, 2,000 yards of pipes had been laid with that object, but the sprays, through no fault of the management, had only just been delivered, and were not yet in use, and I am satisfied that no jury would convict having regard to this evidence.

Should it be quite clear from the confirmation by experts, as suggested above, that the inspector's theory must be correct, then the question, on the part of what persons there has been negligence in permitting or taking part in blasting during the night shift on Saturday, June 23rd, whereby this great loss of life was caused, would become material. If it were due to the negligence of several that the deaths in question have been occasioned, they would all be guilty of manslaughter, and it would be no defence for one who was negligent "to say that another was negligent also, and thus to try and divide the negligence among them." (*See* Reg. *v.* Haines, 1847, 2 C. & K. 368 per Maule, J., at 371.)

Those who took part in blasting during the shift on that afternoon are dead. Those who permitted it, and might and ought to have prevented it, are, in my opinion, the managing director, the agent, and the manager.

The managing director, as he frankly admitted, "overlooked" the question of blasting when he gave way to the men in allowing the alteration in the Saturday night shift. The fact that he made this concession at the request of the men is no defence in law. He knew that blasting was only or mainly done on Saturdays, and it was his duty to see that, as there was no interval between the day and night shift owing to this new arrangement, the instructions with regard to blasting should be revised, and every precaution taken that it should only be done *after* the night shift. This was not done, as has been seen; the instructions remained as they had been before. The same applies to the agent, having regard both to his position (as defined by section 75 of the Act of 1887) and also to his knowledge of the whole circumstances, as well as to the manager. The Albion Colliery is owned by a company limited under the Companies Acts, and I am of opinion that no criminal liability can be said to attach to, and that an indictment for manslaughter would not lie against those directors who had no personal knowledge of, and took no part whatever in the superintendence or management of the colliery. In an action at common law, they would not be personally liable under the circumstances here disclosed. (*See* Wilson *v.* Merry, 1868, L. R., 1 H. L. Sc. 327 at 332 per Lord Cairns, L. C.; and Howells *v.* Landore Steel Co., 1874, L. R., 10 Q.B. 62, per Cockburn, C. J., at 64.) Even under the Employers Liability Act, 1880 (43 & 44 Vict. c. 42), in which the word "employer," by section 8, includes a "body of persons corporate," it would be, strictly speaking, the company, and not the directors *personally*, which would be liable in an action; and where there is no civil liability for negligence at common law, there would in all probability, in the absence of express enactment, be none criminally. H. Lewis, 1225.

With regard to the offences committed against the Coal Mines Regulation Act, 1887 (50 & 51 Vict. c. 58) the "owner" of a mine by section 75 "means "any person or *body corporate* who is the immediate proprietor or lessee or "occupier" thereof. In the present case, therefore, the company is the "owner" of the mine within the meaning of the Act, and liable to its penal provisions. If, having regard to all the circumstances, and moreover to the limitation of three months imposed by section 62, it is thought advisable to take proceedings for offences against the Act, I am of opinion that prosecutions should be instituted in the manner prescribed by sections 61 and 65 against—

(*a.*) William Anstes, the chargeman, for keeping explosives stored in the mine, contrary to, and in breach of, the provisions of general rule 12, sub-rule (*a*).

(*b.*) The company, agent, and manager severally, under section 50 for contravention of and non-compliance with general rule 12, sub-rule (*i.*) (1) and (2), as appears from the evidence of blasting at the point marked C on the plan, during the shift on that Saturday afternoon, and from the other evidence above referred to, for I am of opinion that they did not

take "all reasonable means" by "to the best of their power enforcing" the said rule "to prevent such contravention and non-compliance," and it lies upon them, under section 50, to prove that they did. In addition to the other evidence against them, their depositions before the coroners at this adjourned inquest would, in my opinion, be admissible. (*See* Reg. *v.* Bateman, 1866, 4 F. and F. 1068; and *cp.* Reg. *v.* Coote, 1873, L. R. 4 P. C., 599, and Roscoe's Criminal Evidence, 11th Edition, 1890, at p. 56.) Under section 62 sub-section 2 persons charged with offences against the Act, *may, if they think fit*, give evidence.

With regard to the under manager and his statement that since his appointment, three months before the explosion, he never went down the mine while the night-shift was working, and to the neglect of duty and breach of special rule 42 which this implies, I do not think it quite safe to prosecute him for an offence against the Act, because it is from his own evidence solely that the information was obtained; and, although admissible against him, on his own deposition alone, and without the independent testimony of others, the court might probably not convict.

I cannot advise that proceedings should be taken against the firemen for breach of special rule 69, in not reporting gas if cleared, for no specific or undisputed instance of its having occurred within the last three months is disclosed by the evidence.

(Signed) J. ROSKILL.

Temple,
5th September 1894.

LIST of the WITNESSES called at the adjourned Inquest.
(The Numbers refer to the Pages of the Transcript.)

1st Day.

Richard Griffiths, 1. Timekeeper at the Albion Colliery.
Herbert Gerald Hill, 3. Surveyor of the Albion Colliery.
Philip Jones, 25. Manager.

2nd Day.

Philip Jones. Manager (*continued*).

3rd Day.

Philip Jones. Manager (*concluded*), 322.
H. G. Hill (recalled), 323.
William Garnett, 325–408. Night fireman Grover's side, District 1 *a*.

4th Day.

William Rees, 409–471. Day overman.
Edward Rees, 472–507. Day fireman, Grover's side.
William Rees (recalled), 510–526.
David Evans, 527–546. Day fireman, Grover's side, 1 *a*.
Eli Holley, 546–581. Collier, Grover's side, District 1 *b*.

5th Day.

Evan Davies, 582–590. Collier, day shift.
Henry Hill, 591–618. Day fireman, Grover's side, District 2 *a* and 2 *b*.
William Davies, 619–643. Day fireman, Bodwenarth, District 3 *a*.
John Jenkins, 644–654. Day fireman, Bodwenarth district.
Morgan Dyer, 655–699. Day fireman, Cilfynydd side (far end).
Henry Watkins, 700–720. Day fireman, Pantddu, District No. 4.
Thomas Howells, 721–734. Ripper, Cilfynydd, one of the survivors.
Richard Bumford, 735–773. Ripper, Pantddu district, one of the survivors.
James Graves, 774–785. Pitman.
Richard Griffiths recalled, 786.
William Rowlands, 787–795. Assistant night fireman to David Griffiths, Bodwenarth district No. 3.
Charles Davies, 796–814. Assistant day fireman, Grover's side, Dudson's district, under Henry Hill.
William Jones, I., 815–870. Under manager.
Levi Rees, 871–888. Collier, working place, District 1 *b*, one of the men's examiners.

6th Day.

William Thomas, 889–908. Collier, Bodwenarth district, one of the men's examiners.
William Anstes, 909–934. Chargeman, Cilfynydd side.
Price Wilson, 935–937. Chargeman, Grover's side.
William Jones, II., 938–941. (Speaks to finding his son in Grover engine-house.)
James Smith, 943–947. Timberman, Grover's side.
William Howells, 947–954. Banksman.
Jeremiah Cavalry, 955–963. Master haulier, Grover's side.
William Lewis, 964–1025. Agent of the Albion Colliery.
William Lewis (recalled), 1027–1035. Agent for the Albion Colliery.
Philip Jones (recalled), 1036–1046. Manager.
David Evans (recalled), 1047–1052. Day fireman, Grover's side, 1 *b* district.
William Rowlands (recalled), 1053–1056. Assistant night fireman.

7th Day.

These 11 witnesses were called on behalf of the men.

James Davies, 1057–1091. Night ripper, Grover's side, John Morris' end.
Thomas Owen, 1092–1107. Rock ripper, Cilfynydd side.
John R. Evans, 1116–1122. Rock ripper, Cilfnyydd side, 1 *d* district.
Edward Lewis, 1123–1134. Day ripper, Pantddu district.
Thomas Smith, 1135–1145. Day ripper, Cilfynydd side.
David Romery, 1146–1150. Collier, Grover's side, Dudson's heading.
George Colwill, 1151–1159. Collier, Grover's side.
Hugh Barrow Jones, 1160–1165. Collier, Pantddu district.
Noah Gould, 1166–1188. Rider, Grover's side, Dudson's heading.
Robert Phillips, 1189–1193. Haulier, Grover's side, Dan's heading.
Job Jones, 1194–1202. Timberman, Grover's side, Askett's heading.

Henry Lewis, 1203–1258. Managing director at the colliery.

8th Day.

Henry Lewis (recalled), 1259.
Henry Watkins (recalled), 1299.
William Garnett (recalled), 1314.
Edward Rees (recalled), 1322.
Robert Jenkins, 1328. (Worker in the returns, Cilfynydd side.)
Rowland Williams, 1330. (Night ripper, Grover's side.)
William Rowlands (recalled), 1335.
David Hannah, 1339. Mining engineer, called on behalf of the owners.
John Clifton, 1348. (Assistant banksman on top of pit.)
David Hannah (continued), 1350.
Hugh Bramwell, 1393. Mining engineer, called on behalf of the owners.
Herbert Kirkhouse, 1400. Mining engineer, called on behalf of the owners.
Treharne Rees, 1416. Mining engineer, called on behalf of the owners.
Henry Hall, 1428. Inspector of mines.

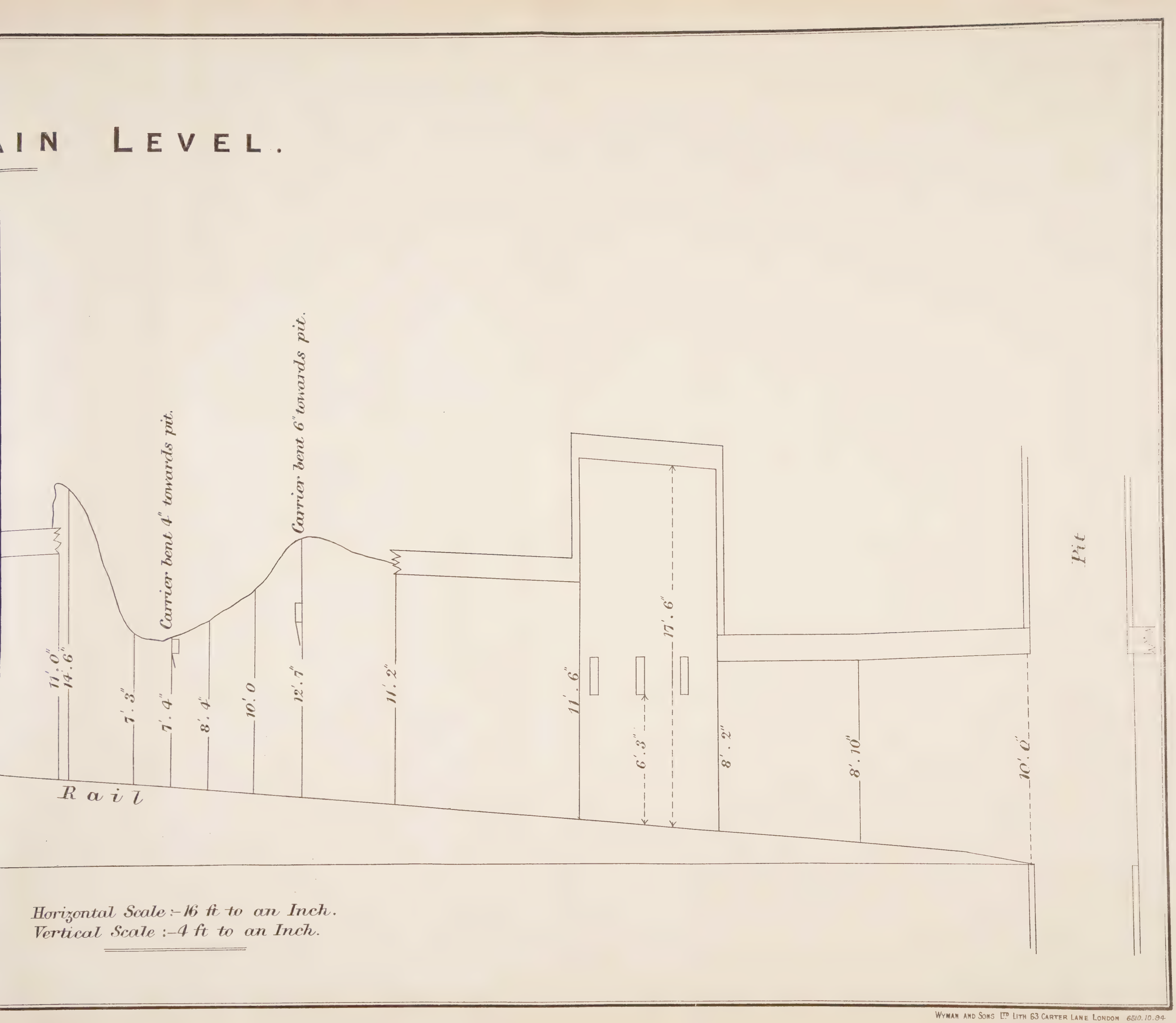
9th Day.

Henry Hall (continued), 1483.
J. T. Robson, 1551. Inspector of mines.
Dr. Lyttle, 1586.
J. T. Robson (continued), 1593.
J. S. Martin, 1611. Inspector of mines.
J. M. Sims, 1626. Assistant inspector of mines.
F. A. Gray, 1637. Assistant inspector of mines.
Coroner's summing-up, 1638, 1651.
Verdict of jury, 1658.

SECTION OF CILFYNYDD MA

※ *This is the fall at the point which is marked B. on the large Plan, it is here that in the opinion of the owners the Explosion originated.*

AIN LEVEL.



Horizontal Scale :- 16 ft to an Inch.
Vertical Scale :- 4 ft to an Inch.

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REPORT

ON

ALBION COLLIERY EXPLOSION;

BY

J. T. ROBSON, H.M. Inspector of Mines for the South Wales District;

HENRY HALL, H.M. Inspector of Mines for the Liverpool District; and

JOSEPH S. MARTIN, H.M. Inspector of Mines for the South-Western District.

About 3.50 on Saturday, 23rd June 1894, an explosion occurred at the Albion Colliery, Cilfynydd, Pontypridd, by which not less than 290 persons lost their lives, and five others received injuries.

We have carefully examined the colliery, and attended the inquest which was held at Pontypridd on 16th, 17th, 18th, 19th, 20th, 24th, 25th, 26th, and 27th July, and now have the honour to report on the circumstances attending the explosion as follows:—

Description of the Colliery.

The Albion Colliery is the property of the Albion Steam Coal Company, Limited, whose registered address is 12, Bute Crescent, Cardiff. It is a comparatively new colliery, the sinking having been commenced in 1885, and completed in 1887. It is situated in the Taff Valley, in that portion of the South Wales coalfield lying between the synclinal on the north and the anticlinal on the south, which portion of coalfield was, until the opening of this colliery, virgin ground north of the Ocean Coal Company's Lady Windsor pits at Ynysybwl, and Harris' Deep Navigation Colliery, now belonging to the Ocean Coal Company, at Treharris.

The area of minerals leased by the Albion Coal Company is about 1,300 statute acres.

There are two shafts, one being the downcast and winding shaft, and the other the upcast shaft. They are 33 yards apart, centre to centre, each 19 feet in diameter, and walled throughout with 9-inch brickwork.

In sinking the following seams were met with, viz.:—

	Ft.	In.		
No. 2 Rhondda - -	4	0	thick, at	128 yards.
No. 3 Ditto - -	2	7	„	226 „
Two feet nine - -	6	0	„	517 „
Four feet - -	6	8	„	545 „
Six feet - -	6	0	„	552 „
Nine feet - -	9	0	„	580 „

The four feet, known locally as the "Upper Four Feet," is the only seam worked up to the present time. It is a first-class steam coal, slightly more bituminous than the steam coals in the collieries centred round Porth on the west, and in those in the neighbourhood of Mountain Ash and Aberdare on the north, and considerably more so than the same seams in the upper portion of the Rhondda Valley, lying further away to the north-west of Cilfynydd.

The following is an analysis of the coal by Edward Riley, Esq., F.C.S., analytical and consulting chemist, London:—

Carbon	89·84	
Hydrogen	5·16	
Nitrogen	0·46	
Oxygen	2·65	
Sulphur	0·51	
Ash	1·38	(colour light buff).
	100·00	

Mr. Riley adds that "dried at 212° F. the sample gave:—

Volatile matter	15·19
Coke	84·81
	100·00

"The calorific value, as determined by Thompson's calorimeter, is 8,270 units of heat, equal to an evaporative power of 15·4 lbs. of water per lb. of coal. It is a sample of the very best quality of steam coal."

The seam is a clean one, varying from about 5 ft. 10 in. to 6 ft. 10 in. in thickness. Immediately above the coal there is generally a strong cliff (shale) which attains a thickness of 11 feet, but in places a clod (argillaceous shale), from an inch up to 15 inches in thickness, intervenes. Occasionally both cliff and clod are wanting, and a rock, which is invariably above the seam at a greater or less distance, forms the roof.

The colliery is well equipped with modern machinery, and laid out for a large output.

Mode of Working.

The workings are on the long-wall method. One portion, where the main rock roof approached within a few inches of the coal seam, has been worked on what is known in this district as the "Nottingham system," in which the stall roads are 50 to 60 yards apart, and the trams are taken along a temporary line of rails parallel, and close to the face, the road being moved forward laterally every 6 or 9 feet as the face advances. This system was discontinued upwards of a year ago. All the remaining workings have been conducted on the ordinary long wall, as practised in the district, having the stall roads about 12 yards apart.

In the long wall method, as the whole of the seam is removed in the forward working, all the roadways necessary for ventilation, and the haulage of the mineral have to be made and maintained through the goaf or "gob," and this is done by stowing; (1) any clod or stone taken down by the colliers; (2) most of the small coal produced in the coal-getting; (3) stone ripped in the roadways back from the face; and (4) rubbish from falls of roof and the débris gathered off the roads and aircourses. In addition to the gob-walls formed of stowage, there are cogs of timber at the sides of roadways, and double timbers on the roadways for supporting the roof and sides where timbering is deemed necessary by the management.

The workings are divided into districts, and at the date of the explosion there were eight of these in course of working, viz., four on the west side of the shaft known as Grover's side, and four on the east side of the shaft known as Cilfynydd side.

Reference to Plan No. 1, accompanying this report, will best enable the position of the various workings and their approaches to be understood, but it may facilitate a proper appreciation of the extent of the roadways and the length of faces opened to give the same in figures as below.

On Grover's side:—The main level had been extended 1,136 yards from the shaft, but was not in course of extension, the last 53 yards of its length having been stowed. On the right-hand side of this level, at a point 708 yards from the shaft, is Llanfabon dip; at a further distance of 118 yards is John Morris' dip, and a still further distance of 254 yards Ned Owen's dip, 1,080 yards from the shaft. The workings reached by these three dips formed at the time of the explosion a district, which for the purpose of this report will be called No. 1 district. It contained 2,521 yards of roadways and 41 working places or stalls, which occupied a face 545 yards in length. The total

length of face opened in this district was then 844 yards, a portion of which, however, had reached the boundary.

At a point 820 yards from the shaft along Grover's level is the entrance to Asket's heading; at a further distance of 112 yards is Tom Williams' heading, and 97 yards beyond this is Nelson's heading. The workings in these three headings formed another district, which will be described as No. 2 district. In it there were 3,260 yards of roadways and 41 working places in an unbroken line of an aggregate length of 528 yards. In addition, there was a short length of 95 yards of face adjoining the main level not in operation, making a total of 623 yards of face in this district, all of which is to the rise of Grover's level.

Coming back toward the shaft, and within 185 yards of it, is the entrance to Dudson's heading, which was extended a distance of 1,126 yards to the rise, the workings on both sides of which above Wedging's heading forming No. 3 district. This embraced 3,244 yards of roadways and 59 working places extending for a distance of 792 yards, all of which was in course of working.

The workings reached by Dan's heading, which branches off to the left 396 yards up Dudson's heading, were included in No. 4 district, This comprised only 12 working places of a length of 167 yards, but there was a further face of 286 yards not in course of working. The length of Dan's heading is 484 yards, and the aggregate length of branches and stall roads in operation 875 yards.

On Cilfynydd side, branching off to the left at 194 yards from the shaft along Cilfynydd level, is the Pantddu dip, which has been driven 814 yards, passing Mordecai's level at 473, D. Thomas' level at 616, and Parker's level at 686 yards, respectively. The working places in this district, called No. 5, number 44, the length of continuous face at work being 594 yards. The total length of roadways in this district, all of which except one are to the right of Pantddu dip, is 2,590 yards.

Following the Cilfynydd level, William Rees' heading to the rise at a distance of 806 yards from the shaft, and David Rees heading to the dip 180 yards further, are reached, and beyond are one short heading to the rise and another to the dip. The total length of the Cilfynydd main level is 1,100 yards. The number of working places in this, No. 6., district is 27, having a length of face opened of 338 yards. The total length of roadways off the main level is 1,720 yards.

Opposite the entrance to Pantddu dip is Bodwenarth incline, which is driven to the rise a total distance of 1,092 yards. On the left-hand side of this incline are David Rees' level at 608 yards, Boucher's level at 861 yards, and Mathew's level at 963 yards from the entrance, respectively. The workings in these levels form No. 7 district, and comprise 43 working places having a face 537 yards in length with only one break of 30 yards in the whole distance, and a total length of roadways amounting to 2,602 yards.

On the right-hand side of the same incline are Dobb's level at 711 yards, and Curley's level at 824 yards, and all the workings on this side of the incline, including 42 working places having a total length of 540 yards without a break and 2,438 yards of roadways, are embraced in No. 8 district.

The above are all the districts in operation. There is a small district lying between the Cilfynydd level and a fault on the left-hand side of the Bodwenarth incline, which was not in operation.

At the date of the explosion there were altogether 4,041 yards of working face and 30,600 yards (over 17¼ miles) of roadways in use for the haulage and ventilation of the colliery.

Haulage.

The principal haulage is by main and tail ropes, the motive power being two steam-engines, one on each side of the downcast shaft, fixed immediately over the main road, that on Grover's side being 42 yards and that on Cilfynydd side 28 yards from the shaft. These engines are supplied with steam from multitubular boilers placed in two separate galleries, one on each side of the shaft, between the main intake and main return, 33 and 37 yards from the downcast shaft, respectively.

The engine-planes on Grover's side comprised that working to Asket's heading, with branches down Llanfabon and John Morris' dips, another working on Dudson's heading to within 150 yards of the face, with a branch along Dan's heading 385 yards from its entrance off Dudson's heading.

On the Cilfynydd side of the shaft the engine plane extended to William Rees' heading on the main road. There was a branch down Pantddu dip 600 yards, and another up Bodwenarth incline 600 yards in length.

The total length of roadways worked by engine power was 4,543 yards.

On all other roads the haulage was done by horses, the number employed being 121.

Ventilation.

The ventilation of the colliery is produced by means of a Schiele fan 15½ feet diameter, exhausting from the upcast shaft, the total quantity of air being about 235,000 cubic feet per minute.

According to the last measurements, taken by Mr. Phillip Jones, the manager, on 20th June, the quantities passing in the different splits were as follows:—

		Cubic Feet per Minute.
1. Grover's level and Llanfabon, No. 1 district		31,480
2. Right hand of Dudson's, No. 2 district		18,336
3. Face of Dudson's round to Wedging's heading, No. 3 district		28,120
4. Dan's district to rise	12,300 (No. 4 district.)	
5. Ditto to dip	10,360 (No. 4 district.)	
		22,660
6. Stables on Grover's side		11,180
7. Pantddu dip, No. 5 district		26,370
8. Cilfynydd level, No. 6 district (including about 4,000 through Lambert's road in New Incline district, not working)		28,114
9. Bodwenarth incline, left-hand side, No. 7 district		20,450
10. Ditto right-hand side, No. 8 district		22,640
11. Stables on Cilfynydd side		16,040
		225,390
To boilers		10,000
		235,390

The various splits were well arranged and the airways of ample sectional area. With two exceptions the air-crossings were made in the solid, a method which, although costly, is to be commended.

In common with the steam coal collieries in South Wales the seam at the Albion colliery produces a considerable quantity of fire-damp in the course of working, and although there are collieries which give off more gas, it is undoubtedly one which should be classed as a fiery colliery. It has had a rather singular immunity from strong "blowers" and "outbursts" of gas, notwithstanding the fact that it was rapidly opened in a comparatively virgin field and could not have been drained of gas by the workings of adjoining collieries. Gas was very seldom reported by the firemen who made the examinations required by the 4th General Rule of the Coal Mines Regulation Act, 1887. It may here be stated, however, that some of these firemen admitted that if they found a little gas accumulated owing to a brattice sheet being down or from other accidental causes, they did not report such accumulation if they were able to clear the gas before the workmen entered the place.

During the 12 months previous to the explosion Mr. Sims, assistant inspector of mines, had made four underground inspections, and Mr. J. Dyer Lewis, assistant inspector, one such inspection, in none of which had any accumulation of gas been discovered. We believe that accumulations of gas were of rare occurrence, and that the mine was usually free from gas.

The return currents would no doubt contain a small proportion of fire-damp, but from time to time these had been examined for gas by the assistant inspectors and no decided "cap" had ever been detected by them.

No complaint was ever made to Mr. Robson, the inspector in charge of the district, of the existence of gas in the workings, either from any sudden outburst or other cause.

Lighting.

Safety lamps of the bonneted Clanny type were in general use by the workmen in the colliery. This type of lamp has been found by experiments made in the district to be in accordance with the provisions of the Coal Mines Regulation Act, 1887, which imposed greater restrictions in the construction of safety lamps to be used than existed previously.

There is an electric light installation at the colliery, but it was out of order and had been so for some weeks prior to the date of the explosion. Open "comet" lights were substituted for the incandescent lamps formerly used at and near the bottom of the downcast shaft.

Naked lights were allowed at each of the lamp stations, of which there were seven in use during the day shift, but only two during the night shift, viz., one on the main level at the entrance to Pantddu dip, and the other at the entrance to Dudson's heading. The position of all the lamp stations will be found marked on No. 1 and 2 plans.

The only other open lights allowed in the mine were the boiler fires on each side of the shaft already referred to.

Blasting.

Explosives were not used in actual coal-getting, nor in the removal of the cliff (shale) immediately above the coal, but they were used for ripping the rock overlying the cliff where necessary in order to maintain sufficient height in the roadways. Explosives were also used for the purpose of removing timbers, which through subsidence of the roof had become too low. According to the statement of the officials this blasting of timbers was only resorted to when the timbers were supporting strong rock roof and in positions where the span was not less than 13 feet, as on a double parting having two lines of rails. In any case, it was a most unusual proceeding in coal mining, as to which reference will be made later on in this report.

The explosives used were gelatine-dynamite and gelignite. Shots were fired by means of fuse, the firemen and overmen being the persons authorised to fire shots. A man in each shift was appointed to take charge of the explosives, detonators, and fuse.

The manager had, it appears, given instructions that shots were only to be fired in the interval between shifts, but this had not been adhered to, at any rate on the day of the explosion, as referred to later on.

Coal Dust and Watering.

The seam produces a large quantity of coal dust in working, and much dust is deposited on the roadways, being shaken and blown from the trams in their passage between the faces and the shaft.

With the exception of a few dip stalls in Nos. 1, 5, and 7 districts, which stalls are naturally damp, the whole of the working places are dry and dusty.

In about 14 places on roadways a little water percolates through the roof, but these places are of small extent and have no practical bearing on the general question of the dryness of the mine as a whole.

On Grover's side some water was pumped by a horse-pump from a short dip at a distance of 570 yards from the shaft through a line of pipes laid to the sump at the shaft. It was stated that some of this water was allowed to escape at the joints and through holes bored in the pipes for the purpose of damping the floor of this main road.

About seven casks of water were filled every day in the Llanfabon dip, and this was put on the roads of Nos. 1 and 2 districts with the object of laying the dust.

The water which collected in No. 5 district in Pantddu dip, was pumped up to a tank fixed 418 yards from the entrance of this dip off Cilfynydd level, which point is on the rise side of an upthrow fault, and just at a sufficient elevation for the water to run through a line of pipes outwards to Cilfynydd level. The roof of this dip had been ripped, and the road raised considerably on the shaft side of the fault, but still there was a "swamp" or hollow in which water lay.

On the left-hand side of the Bodwenarth incline, a small quantity of water was pumped from the face on to the straight road, and allowed to find its way to the shaft. Where this road passes through faulty ground it is dead level, and is wet on the floor

for a distance of 160 yards, below which point on the incline it was only dampish, getting less so nearer to the shaft.

As is the custom in large collieries, a supply of clean water was conveyed by means of pipes from the surface for the horses. This supply was, it is stated, also made use of to water some of the roadways by means of casks and tanks filled at a tap near the stables on Grover's side; and, by allowing the tap to run, water is said to have flowed at times along Grover's level, which it may here be observed, has a dip gradient of about four inches per yard from Dudson's heading to Llanfabon dip.

There is no doubt in our minds that the general condition of the roadways in the colliery was "dry and dusty," and that the attempts at watering only partially damped the floor, leaving the sides, roof, and timbers covered with deposits of the finest coal dust.

Official Staff.

Mr. Henry Lewis, of Wallnut Tree Junction, is the managing director of the Company, and acts on behalf of the owners. He is a mining engineer, with a large experience in steam coal collieries in South Wales. Mr. D. Ellis is secretary, and resides at Pontypridd. Mr. William Lewis, who holds a first-class certificate of competency as a colliery manager, is the resident agent, and Mr. Phillip Jones, the certificated colliery manager, having obtained his certificate by examination on 22nd July 1887.

At the time of the explosion, William Jones, son of the manager, was acting as certificated under-manager in the absence, through ill-health, of John Jones, the regular under-manager. William Rees was day overman, and John Evans, now deceased, was night overman.

There were eight firemen by day and eight by night, as well as some assistant firemen and brattice men.

Mr. Lewis, the managing director, also from time to time visited the underground workings, and was generally in daily communication with the officials.

Working Shifts and Persons employed Underground.

Coal working was pursued both by day and night, and although the quantity of coal actually worked during the night formed only about 25 per cent. of the total quantity raised, the colliery may properly be considered as one working on the double-shift system, which is an unusual practice in South Wales.

The number of persons employed underground in the day shift was about 1,020, and in the night shift about 524. On the first five working days of the week there was an interval between the day shift ending at 5 p.m., and the night shift beginning at 7 p.m.; there was a similar interval between the night shift ending at 5 a.m., and the day shift commencing at 7 a.m.

On Saturdays no coal was raised after 2 p.m., when the day shift ended, and the night shift immediately began to descend, so that there was no interval at all between shifts on Saturdays. It may here be noticed that this arrangement had only been in operation for five or six weeks prior to the explosion, previous to which there had been an interval of one hour between the day shift ending and the night shift commencing on a Saturday. This alteration had been made at the request of the workmen to enable them to finish work at 8 p.m., instead of 9 p.m., as formerly.

Road repairing and cleaning was carried on during the week in both shifts, but Saturday afternoon was specially devoted to clearing away the rubbish and dust from the main roads of the colliery.

The rapid development of the colliery may be judged from an examination of the plan, bearing in mind that coal work was only begun in the latter half of 1887. Before the end of that year as much as 1,000 tons per day had been raised from the mine.

The output for the week ending 23rd June (the day of the explosion) was 9,542 tons of large coal, of which 7,170 tons (about 75 per cent.) were cut by day and 2,372 tons (about 25 per cent.) by night. As regards the quantity *raised* the two shifts were more alike, for of the total output of large coal, 5,237 tons (about 55 per cent.) were raised to the surface by day and 4,305 tons (about 45 per cent.) by night.

The gross output of large and small was about 11,500 tons per week, or fully 1,900 tons per day.

A calculation from the plan of the workings shows that, altogether, 338 acres of the seam have been exhausted.

The Explosion.

Shortly before 4 p.m., and within two hours after the descent of the dusting and repairing shift, those on the surface were startled by two loud reports in quick succession, followed immediately by a rush of dust and smoke from the downcast and then from the upcast shafts. No flame appears to have been observed, at any rate by those close to the mouth of the shafts, but as these men were thrown backwards, and blinded for a few moments by the rush of dust, it is probable that some flame did actually reach the top of the downcast shaft. Those nearest to that shaft felt the hot blast, and one or two complained of their eyelashes having been scorched.

The first blast blew away some of the planking forming the stage round the downcast, and the second displaced the wooden covering from the top of the fan drift. Fortunately the fan itself was uninjured and continued to work.

After temporary repairs had been hurriedly made to the fan covering, the manager, under-manager, and others, including some of the day firemen, made a descent in one of the cages in the downcast shaft, and shortly afterwards these men were reinforced by other officials and workmen as well as by managers, officials, and workmen from neighbouring collieries, who, as usual in such emergencies, never fail in hurrying to the scene of disaster to offer their service in the rescue of their fellow men.

It was soon discovered that a most serious calamity had occurred, for dead bodies were found quite near the shaft. In a little time the explorers came upon some who were alive, but suffering from burns or after-damp, or both. These men were soon attended to by Dr. Lyttle, medical officer at the colliery, who had descended the mine with the first explorers. Only 16 were found alive and brought to the surface, 11 having been found on Cilfynydd side and 5 on Grover's side; but of the 16 only 5 have recovered, the others dying from their injuries within the following few days.

Ten of the 11 men brought out alive from Cilfynydd side were found between the entrance to Pantddu dip and the air-crossing 83 yards along this road. It is believed that all of them had travelled from the workings in Pantddu, or No. 5 district, after the explosion occurred. The eleventh man, who recovered and was able to give evidence at the inquest, states that he was in the lamp station when the explosion happened, having just come from the Bodwenarth incline to re-light his safety lamp. He describes having seen what appeared a blue flame coming from the shaft side of him, but neither heard nor felt anything, and remembers absolutely nothing else.

None of the five found alive on Grover's side, between the shaft and the entrance to Dudson's heading, have survived their injuries.

It was impossible to ascertain the exact number of persons in the mine when the explosion occurred. On that night, and for some days afterwards, all that was known was that 13 cage loads of 20 men each had descended at 2 p.m. or shortly afterwards, and 2 fitters a few minutes before the explosion. There were no means of knowing the number of men belonging to the day shift that had remained down, but it was soon ascertained that some had done so. As far as can now be ascertained, there were 295 persons in the mine when the explosion occurred. A list of the persons killed is appended.

John Evans, the night overman, William Roberts, the man in charge of the explosives in this shift, and six night firemen were amongst those in the mine, together with a large number of labourers, of whom some were not personally known to either the manager, under-manager, or day firemen.

Mr. Robson and two of the assistant inspectors of mines, Messrs. F. A. Gray and J. Dyer Lewis, arrived from Swansea and Neath at 11 o'clock on the evening of the explosion, and after a short consultation at once descended the shaft, where they met Mr. William Lewis, the agent, Mr. Phillip Jones, the manager, and Mr. J. Mancel Sims, assistant inspector of mines.

By 3 a.m. on Sunday Mr. Robson and his assistants had penetrated as far as the double-parting on Grover's side on the outer side of Asket's heading and 90 yards down Llanfabon dip, at which points their advance was prevented by heavy falls of roof, which completely blocked the roads.

Previous to the descent of the inspectors some of the bodies found on the main levels and Pantddu dip had been removed, beyond which nothing had been done in the mine except what was necessary to restore the ventilation and rescue the men found alive; so that the inspectors were at an early period able to note matters very much as left by the explosion, as well as to examine the condition of the floor of the main levels as to their dryness.

On the forenoon of the same day (Sunday) they were also able to examine most of Cilfynydd level and Pantddu dip, and on the evening Mr. Martin arrived and made an examination of the underground roads and portions of the working faces.

On subsequent days the colliery was carefully examined by each of us, and also by Mr. Robson's three assistants. Everything was minutely examined which was likely to afford any clue to the extent of the explosion or its origin; all signs of force exhibited by trams, timbers, bodies of men and horses, as showing the direction of the blast were carefully noted, and special care was taken to ascertain whether coal dust or fire-damp had been the chief agent in the explosion.

Extent of the Explosion.

It was soon apparent that, with the single exception of Pantddu dip, the explosion had passed along every main road in the mine, and into most of the branch roads.

We are of opinion that the blast reached a certain distance down the Pantddu dip, but did not extend throughout in consequence of the damp condition of the road and the absence of dry coal dust. Had the explosion been extended into the branch roads in No. 5 district, which is reached by Pantddu dip, in all probability none of the men in it would have been able to leave, as they undoubtedly did. Moreover, two horses were found alive and uninjured in this district—the only two which were saved. It is well known that horses readily succumb to the effects of after-damp, but these two had not apparently suffered at all.

One of the survivors, named George Bamford, said he was working with others on the double-parting on Mordecai's level, in No. 5 district, when the explosion occurred, and thus describes it: "I heard a sound like thunder—the biggest I ever heard. I "heard two sounds with scarcely any interval—each just the same noise. I thought "it was an explosion and stood where I was. I heard the door between us and the "engine-dip parting open and shut with a bang. The level directly after (less than a "minute) was filled up with dust and our lamps went out. There were four of us "together and two more inside. I think I saw a shade of flame in the dust of a "bluish colour. It was coming above us along near the roof. I was standing up. "The place was about 7 feet high. We started off then to walk to Pantddu dip. We "met after-damp in the parting near Pantddu dip. The flame and dust passed over "us and we came out. In Pantddu dip the after-damp was strong, and I recollect no "more until I came to myself, when Dr. Lyttle and Henry Watkins were with me at "the air-bridge. I heard someone say at home that it was about 8 o'clock when I got "out. I was not singed by the flame, except my eyelashes a little. The light I saw "among the dust was like a flash, and about a foot from the roof."

The explosion did not reach the working places in No. 3 district, at the top of Dudson's heading, or if so, it must have been only to a limited extent, as nothing was disturbed in them. A further proof of this is that most of the men lost in this district had evidently escaped the blast, and had time to gather together in groups, and were suffocated by after-damp. In one of the groups there were no less than 37 bodies.

There were indications of force on Dudson's heading up to a point within 127 yards from the face, beyond which no signs whatever were observed. At the point referred to there had been considerable force, the body of one poor man, believed to be that of the fireman of the district, having been blown to pieces. With the exception of those found on the main heading outbye of this point, and on some of the adjacent branch roads, all in this, No. 3, district had escaped burning and died from suffocation by after-damp.

In Nos. 1, 2, 4, 6, 7, and 8 districts there was abundant evidence that the explosion had reached and passed through most of the roads and working places. In these districts both men and horses were for the most part burned, but after-damp was probably the immediate cause of death in the majority of cases.

On all main roads, except Pantddu dip, into No. 5 district, the bodies of men and horses were burned.

In addition to the case referred to on Dudson's heading as showing great force, a haulier on Llanfabon dip was blown to pieces, the head and limbs being completely severed from the trunk and the portions found 25 yards apart.

Other bodies found at the top of John Morris's dip, and the body of a haulier down that dip, were much mutilated, as were also some found near the bottom of Dudson's heading.

On the opposite side of the shaft, one body found near William Rees's heading, on Cilfynydd level was much shattered, while another on Bodwenarth incline, near David

Rees's heading, had the head and one foot blown off. These points are situated at a distance of 1,672 and 1,650 yards respectively from where the body of the haulier was found mutilated on John Morris's dip.

There was evidence that the explosive force extended a short distance into some of the return airways and then died away.

Direction of Force.

All the doors separating the intakes from the returns were found blown from the intake side to the return side. All other doors were blown inwards towards the face. The brick partitions and iron doors in the boiler gallery on Grover's side were found blown towards the return, but those in the boiler gallery on Cilfynydd side were found blown towards the intake.

The two air crossings which were not in the solid, viz., that at the stables on Grover's side and that on Dan's heading, at the entrance to No. 4 district, were both blown from the intake into the return.

From Llanfabon dip, on Grover's level, there was unmistakable evidence that the force was inwards towards the face in each direction.

On Dudson's heading it was apparent that the force was inwards towards the face and also on Dan's heading inwards towards the face.

On Cilfynydd side, from the stables inwards, there was conclusive evidence of an inward force on the level and an inward or upward force on the Bodwenarth incline.

From the above indications it will be seen that the origin of the explosion must have been somewhere on the main level between Llanfabon dip, on Grover's side, and the entrance to the stables on Cilfynydd side, which points are situated 858 yards apart. Between these points there were indications in both directions, but after several most careful examinations we are decidedly of the opinion that a preponderance of evidence tended to show that the blast came outwards from a point near the horse-pump dip on Grover's side. We are strengthened in this view by the fact that Mr. Robson and his assistants were satisfied on the night of the explosion that of the timbers displaced by the blast on this level more showed an outward than an inward force, and Mr. Martin arrived at the same conclusion on the Sunday night following the explosion.

On the Cilfynydd level, between the shaft and the stables, some iron straps used to support pulleys carrying the haulage tail-rope, were found bent towards the shaft; these indications were noted by Mr. Robson and Mr. Gray on the Sunday following the explosion, and favour the contrary view, that the explosion passed outwards from the stables to the shaft on the Cilfynydd side. One of the day firemen, William Davies, gave a clear account of his observations on this point, and was distinctly of the opinion that one of the iron straps referred to was bent inwards, while trams on the shaft siding appeared to have been blown both inwards and outwards, and that the indications were, as he described them, "complex."

We think the conflicting evidence of force, in this neighbourhood, may be accounted for by the blast passing through the stables into the return, and then outwards through the return, dividing again at the separation doors, and then outwards to the shaft.

It may here be observed that in nearly all large explosions there are some conflicting signs of force, and that it is often extremely difficult, if not impossible, to fix upon a point where an explosion originates, by an examination into the evidence afforded by indications of force alone.

Coked Coal-dust and Charring.

The principal places where timbers were found charred, were near the top of Dudson's heading in No. 3 district, near the face of Cilfynydd level in No. 6 district, near the face in Tom Williams's heading in No. 2 district, and at a point 35 to 40 yards inbye of the horse-pump dip in Grover's level, where the largest amount of charring was observed on some collars.

Coked coal dust was found on some props and trams of coal at the face of No. 1 district, on several props and some trams of coal in Tom Williams's heading in No. 2 district, on a few props and one tram of coal in No. 4 district, all on Grover's side.

Coked dust was also found on a few props at and near the face in No. 6 district, also in Nos. 7 and 8 districts, and in the small district not working, all on Cilfynydd side.

In each of the places mentioned, the deposits of coked coal-dust were of considerable extent, the thickest being observed in No. 2 district, where several props at the face were found thickly covered all round from top to bottom. In most of the other cases the deposit was only on one side of the props.

It was stated that coal dust was found on fire on the Cilfynydd side, within a short distance of the shaft, and the clothes of the engineman on that side of the shaft, as well as some of the woodwork of the engine, were also found burning when the first exploring party reached them.

Location of Explosion and its Cause.

From what has already been stated in this Report, it will have been seen that in our view the explosion was initiated on Grover's side. This, however, was not the view expressed by some of the officials, and by the mining engineers called as experts on behalf of the owners at the inquiry before the coroners and jury. These gentlemen stated that in their opinion the disaster was caused by a sudden outburst of gas, and they fixed upon a spot where a large fall of roof had occurred near the entrance to the stables on the Cilfynydd side of the downcast shaft as the point of origin, the gas having been ignited at one of the open lights allowed at this place. They all admitted that they had found no indications of gas at the place, nor had they heard of any having been found there before or after the explosion; that it was a most unlikely place, in view of the experience in working the mine, the length of time the place had been open, and its distance from the face; and that with the large volume of air (118,754 cubic feet per minute) passing the place, such an occurrence was extraordinary if not unprecedented.

It was admitted by the officials that on the fatal Saturday timbers were to be taken out in three different places on the main engine plane, viz., on the double parting near William Rees's heading on the Cilfynydd main level; on the double parting near Asket's heading on Grover's level; and at a point about 40 yards inbye of the horse-pump dip on Grover's level. It was also admitted that at the two double partings mentioned the timbers would be removed by blasting, but it was denied that the timbers in the third place would be blasted. These being only 9-feet timbers, and not under rock roofs, it was stated by the management that they would be taken out by hand in the usual way, *i.e.*, by cutting partly through the arms, and drawing or knocking them out.

There can be no doubt that the timbers on Cilfynydd side had been blasted, for there was evidence that shot-holes had been bored in them during the day shift; besides, the bodies of repairers and labourers, a horse, and a tram filled with stones, were found close to the spot, clearly proving that these men had been engaged clearing away the débris brought down by these shots.

The blasting of the timbers on the double parting on Grover's side had not been carried out before the explosion, as on the Wednesday following four unexploded charges of gelatine-dynamite were found by the men while clearing the heavy fall of roof which had occurred at the place. These charges were in the arms or uprights of the timbers which had to come out, and which were still standing; the collars were, of course, broken down under the large fall of roof, and in them at least one charge had exploded, probably by the flame from the explosion having ignited the fuse.

At the third place, referred to above, where timbers had to come out, there was a fall consisting of about eight trams of rubbish and old timbers. Both inside and outside of this point nothing was disturbed for about 90 yards, although the road here was closely timbered and lagged. On the inbye side of this fall there was a space of 6 ft. 4 ins. up to the solid roof, of which 4 ft. 3 ins. were filled with laggings and débris from the roof and sides, leaving a cavity fully 2 feet high in the centre, but less on each side of the roadway. On the outbye side of the fall there was a height of only 2 ft. 11 ins. from the collar up to the roof, and, with the exception of a small cavity in the middle of the roadway, this space was filled with laggings and débris. The road dips slightly inbye, and this fact, together with the inequality in the height above the timbers, would favour the accumulation of any gas which might possibly be given off from the broken strata above the timbers. It is true there were 31,000 cubic feet of fresh air passing along this roadway, which was from 7 to 8 feet high, and from 7½ to 10½ feet wide inside the timbers. No gas had, it seems, been seen on it, but as the roof was all supported by closely-lagged timbers, with a covering of stones over the laggings, there was no opportunity for examining above the timbers, except by removing some of the laggings, which we think was never done. In our experience of similar places in such a condition, we think the cavity above the timbers was not an unlikely place for gas to lodge in, and we believe that there may have been an accumulation there. But we think the presence of gas is not a necessity to account for an explosion in a colliery so dusty as this, more especially on the face of the evidence of the Camerton explosion, and that afforded by Mr. Hall's experiments.

At the entrance to the horse-pump dip the bodies of Morris Ashton, fireman, and William Roberts, the man in charge of explosives, were found, and a few yards down this dip the body of John Evans, the night overman, was found. Both fuse and detonators were found on Roberts. These three men were those whose duty it was to examine the place, prepare the charges, and fire the shots, if shots were to be fired in the vicinity. Inside of the fall referred to, the bodies of David Llewelyn, timberman, and William Jones and Owen Hughes, rippers, were found. Llewelyn was said to have been found two or three yards nearer the fall than Jones and Hughes, both of whom were found across the roadway with their feet in a manhole. This manhole is nine yards further in than the inner edge of the vacancy in the roof caused by the fall referred to.

The position of these bodies was described by William Evans, day overman, to Mr. Robson and two of his assistants on the night of the explosion, the bodies having then been removed.

It was attempted to be shown by the management that the fact of the repairer being found so near the fall was in itself evidence that no shots were fired in these timbers; but in our opinion this is by no means inconsistent with the firing of shots there, because it is quite possible, indeed probable, that the man would move some little distance after the explosion originated. We think the three men were in the manhole, sheltering from the shots when the explosion occurred, and that the positions in which their bodies were found were compatible with experience in other cases where the force was comparatively small at the seat of the explosion.

This fall, near the horse-pump dip, which was fixed upon by the inspectors as the origin of the explosion, was cleared before it was discovered that any shots at all had been fired on this side of the pit; but some timbers supposed to have formed part of those cleared from the place were discovered and brought to the surface, with the view of their examination in daylight. One piece looked much like what a piece of timber would be if shattered by the explosion of a shot, and there were also indications not unlike that of a shot-hole bored by an auger.

Evidence was given by a haulier, named Robert Phillips, who said he came up the pit a few minutes before the explosion. He had been detained by the hitcher at the bottom while he sent up some trains, and saw John Evans, the overman, and another man unknown to him, hurry from Cilfynydd to Grover's side of the shaft 10 or 15 minutes before he ascended the shaft.

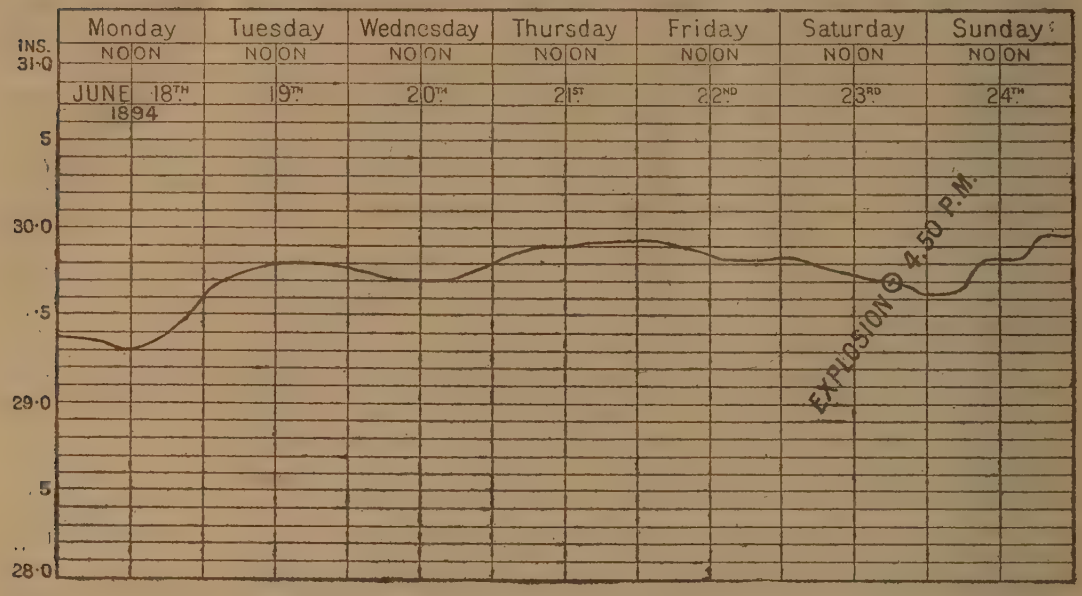
Thus we have a chain of evidence bearing on the explosion and its cause. First, there is blasting in timbers admitted on both sides of the shaft; secondly, shots fired in timbers on Cilfynydd side some time before the explosion; thirdly, the overman who directed the blasting seen hurrying to Grover's side, and his body and that of the fireman and the explosives' man found on one side of the fall, and the repairers on the other side of this fall—the place being one where timbers were to be removed that day. These facts appear to our mind conclusive that shots were being fired at this point in the colliery at the moment of the explosion.

This conclusion was arrived at after giving the matter our best attention and consideration, and we are convinced that the primary cause of this terrible explosion was the firing of some gelignite, or gelatine-dynamite shots in timbers; that these shots either ignited fine coal dust directly, or a small accumulation of gas over the timbers, which in its turn ignited the dust in the vicinity, and was carried forward by the continuous train of dust existing in the roadway; and that the disastrous and far-reaching effects of the explosion were entirely due to coal dust.

Plan No. 2 has been prepared to illustrate the force of the explosion and its effects. It is noteworthy that the falls of roof were for the most part confined to the intake airways. Nearly all the bodies found on the main and branch roads traversed by the blast presented a blackened appearance; this we think is strongly corroborative of the conclusion we arrived at, that the explosion was almost entirely due to coal dust and not to gas, except, perhaps, at its inception. Messrs. H. Kirkhouse, Treharne Rees, D. Hannah, and H. Bramwell, mining engineers, as well as Mr. Henry Lewis, managing director, all expressed as their opinion that coal dust had extended the explosion.

Although we do not think that meteorological conditions had any influence on the state of the mine or bearing on the explosion, we have thought it well to mention that the weather was rather dull during the day of the explosion, and to give the following chart showing the state of the barometer during the week. It will be seen that, following two days on which the barometer had been comparatively steady, it had been falling for about 15 hours when the explosion occurred.

BAROGRAM from SELF-RECORDING ANEROID, taken at Albion Colliery, Pontypridd, from June 18th to June 24th, 1894.



Contraventions of Act.

It was conclusively shown that the Coal Mines Regulation Act, 1887, had been contravened in more than one respect.

The place where shots were fired on Cilfynydd side was on the engine plane or "part of a main haulage road," and thus *both* the conditions mentioned in sub-head (*h*) of General Rule 12 should have been observed. These conditions are:—

(1.) Unless the place of firing, and all contiguous accessible places within a radius of twenty yards therefrom, are, at the time of firing, in a wet state from thorough watering, or other treatment equivalent to watering, in all parts where dust is lodged, whether roof, floor, or sides; or

(2.) In the case of places in which watering would injure the roof or floor, unless the explosive is so used with water or other contrivance as to prevent it from inflaming gas or dust, or is of such a nature that it cannot inflame gas or dust:

We are of opinion that the first of these conditions was not carried out so far as was reasonably practicable, and that the second was entirely ignored, the shots being fired by ordinary fuse and without tamping.

General Rule 12 (*a*) was also contravened, for 23 lbs. of gelatine-dynamite and gelignite were found to have been stored in the mine at the time of the explosion.

General Rule 4 requires that "a report specifying where noxious or inflammable gas, "if any, was found present . . . . . shall be recorded without delay in a book "." by the person who made the inspection. This, as previously stated, was not strictly observed by the firemen generally.

It is of the utmost importance that all gas, however small in quantity, should be recorded, and we are distinctly of opinion that the law requires this to be done; but this is a matter which there is reason to believe is now more than ever likely to be omitted, for the following reason, viz., under General Rule 12 (*g*):—

"(*g*.) If in any mine, at either of the four inspections under Rule 4 recorded last before a shot is to be fired, inflammable gas has been reported to be present in the ventilating district in which the shot is to be fired the shot shall not be fired—

"(1.) Unless a competent person, appointed as aforesaid, has examined the place where gas has been so reported to be present, and has found that such gas has been cleared away, and that there is not at or near such place sufficient gas issuing or accumulated to render it unsafe to fire the shot; or

"(2.) Unless the explosive employed in firing the shot is so used with water or other contrivance as to prevent it from inflaming gas, or is of such a nature that it cannot inflame gas."

In our opinion the persons who are responsible for these contraventions of the Act are (1) Mr. Henry Lewis, the managing director, (2) Mr. William Lewis, the agent, and (3) Mr. Phillip Jones, the certificated manager.

The Inquest.

After a most patient and exhaustive inquiry, occupying nine days, before Coroners E. B. Reece, Esq., of Cardiff, and R. J. Rhys, Esq., of Aberdare, and an intelligent jury of 17 gentlemen, the following verdict was arrived at :—

"The jury find that the deceased had lost their lives through an explosion of gas that took place at the Albion Colliery, on the 23rd of June 1894, which explosion was accelerated and extended by coal dust; but the jury disagree as to the exact place at which the explosion had its origin, and we are unanimously of opinion that shot-firing was practised in the colliery when the men were at work, without sufficient precautions as to their safety, and contrary to rules; we are also of opinion that the under-manager neglected his duty in not seeing that his subordinates in the night shifts performed their duties in accordance with rules; that the firemen were negligent in not reporting gas when found, and that there is not a proper system of watering in this mine. The jury beg to make the following recommendations :—

"1. That shot-firing in timber shall be absolutely prohibited.
"2. That all old workings shall be properly stowed or gobbed.
"3. That a record shall be kept of the number of men in the mine at all hours.
"4. That thorough inspections shall be more frequently made by Her Majesty's Inspectors, because we consider the present examinations by the workmen's representatives worthless."

It will be seen that the jury did not directly connect the explosion with shot-firing, though their first and strongest recommendation has reference to blasting. Possibly, the evidence of the officials and mining engineers, being in direct opposition to that tendered by ourselves and Messrs. Gray and Sims, assistant inspectors, gave rise to some uncertainty in their minds as to this matter.

For the same reason, probably, they were unable to agree as to the place where the explosion was started.

In other respects the verdict is entirely in accord with our views.

We think the omission by the owners' representative to arrange the blasting, when he sanctioned the alteration of hours on Saturdays, was a most serious oversight.

With reference to some of the recommendations of the jury we desire to make the following observations :—

(1.) As to shot-firing in timbers, we concur in their recommendation that this should be absolutely prohibited. It is unnecessary to remove timbers by blasting as they can be removed in other ways, and, indeed, having recourse to explosives for this purpose is most unusual and contrary to good mining. Until this explosion happened we had never heard that such a thing was attempted.

(2.) That all old workings shall be properly stowed or gobbed. This is desirable for safety in long-wall workings, but so long as old workings are adequately ventilated a mine is not necessarily unsafe by reason of old workings being left open. We are of opinion that the proportion of old workings left open in this colliery was not excessive; moreover, that such as did exist had no influence in extending the explosion and thus increasing the loss of life.

(3.) That a record shall be kept of the number of men in the mine at all times. This also is a reasonable recommendation. In safety-lamp collieries it can be readily carried out provided each person on taking his safety lamp from the lamp room on the surface leaves in its place a token or tally with a number corresponding to that of his safety lamp.

(4.) We do not agree with the jury that the workmen's inspections are worthless: on the contrary we think that, when properly carried out, as they generally are in South Wales and Monmouthshire, they cannot fail to do much good.

In concluding this Report we take the opportunity of impressing on owners and managers of mines the urgent necessity that exists for dispensing with the use of explosives as far as possible, and that where used only the safest that can be obtained should be allowed or used.

We also recommend that all shots should be properly tamped with clay and fired by electricity; and that blasting should only be carried on while not more than 10 persons are in the mine.

It does not appear that gunpowder was used in the Albion Colliery. It is, however, largely used in many collieries in South Wales and in some other districts, even where the mines are fiery and worked with safety lamps, as well as being dry and dusty. We think that blasting with gunpowder and other flaming explosives should be abolished altogether in the working of such mines.

With regard to dealing with coal dust in mines we are of opinion that all main roads should be systematically watered, and that the dust thus damped should be frequently removed from the roads and sent out of the mine.

We also recommend that all safety lamps should be provided and maintained by the colliery owners, and not be, as at the Albion Colliery, the property of the workmen. In this matter of safety-lamp regulations there appears to have been considerable laxity on the part of the management, inasmuch as the manager stated that the rules of the colliery and his orders were that no lamp in use at the mine should be taken away from the premises, but this was not carried out, it being alleged that there was not sufficient provision for cleaning and trimming the number in use at the colliery.

We have, &c.

(Signed) J. T. ROBSON.
HENRY HALL.
JOSEPH S. MARTIN.

To the Right. Hon. H. H. Asquith, Q.C., M.P.,
Her Majesty's Principal Secretary of State,
Home Department, Whitehall.

List of Persons Killed.

Nos.	Names.	Reputed Age.	Occupation.	Remarks.
1	James Quartley	30	Ripper.	
2	Frank Joyce	24	Labourer.	
3	John Evans	49	Overman.	
4	James Cullan	26	Assistant ripper.	
5	William Oliver	55	Ripper.	
6	Arthur Jennings	21	Labourer.	
7	Richard Herbert	48	Ripper.	
8	Thomas Jones	28	,,	
9	William Dobbs	50	Fireman.	
10	Gilbert Roff	16	Door-boy.	
11	David Watkins	26	Haulier.	
12	Thomas Burton Jones	32	Ripper.	
13	John Evans	25	,,	
14	Lewis Howells	32	,,	
15	John Hughes	17	Door-boy.	
16	William Parry	20	Haulier.	
17	Isaac Comely	22	Labourer.	
18	Hugh Pugh	27	Timberman.	
19	William Jones	29	Ripper.	
20	William Roberts	39	,,	
21	William Morris	42	Collier.	
22	Richard Owen	20	Haulier.	
23	Benjamin Stubbs	17	Door-boy.	
24	Arthur Timbs	30	Labourer.	
25	Evan Davies	17	Shackler.	
26	Morris Ashton	33	Timberman.	
27	Llewelyn Rees	43	Ripper.	
28	George Watkins	18	Door-boy.	
29	William Richards	19	Labourer.	
30	George Provis	33	Ripper.	
31	Charles Saunders	43	Assistant ripper.	
32	Walter Price	21	Haulier.	
33	Henry Morgan	18	,,	
34	William Hughes	25	Ripper.	
35	William Williams	47	Haulier.	
36	John Ashton	27	Ripper.	
37	John Stott	23	Haulier.	
38	William Thomas Hopkin	20	,,	
39	Joseph Grey	20	Shackler.	
40	Thomas Evans	38	Ripper	
41	David Pugh	27	,,	

Nos.	Names.	Reputed Age.	Occupation.	Remarks.
42	John Webb	38	Assistant timberman.	
43	George Williams	35	Haulier.	
44	William Jones	26	Fitter.	
45	Thomas Haynes	17	Door-boy.	
46	David Owen James	25	Stoker.	
47	John Evans	48	Fitter.	
48	John Parfitt	45	Labourer.	
49	Sidney Cox	22	Assistant ripper.	
50	Hugh Pugh	32	Ripper.	
51	James Stevens	40	Labourer.	
52	Frank Topp	22	„	
53	Thomas Smith	31	Engine-man.	
54	Edmund Daniels	16	Door-boy.	
55	John Herdidge	25	Roadman.	
56	David Llewelyn	39	Timberman.	
57	Richard Thomas	30	Haulier.	
58	Edwin Godwin	47	Labourer.	
59	James Burns	18	Door-boy.	
60	Edward Bowden	14	„	
61	Ellis Jones	40	Ripper.	
62	Nathaniel Edwards	19	Haulier.	
63	Owen Hughes	25	Ripper.	
64	David Morris	40	Roadman.	
65	John Kerslake Cann	28	Pumper.	
66	George Burford	20	Haulier.	
67	David Griffiths	36	Fireman.	
68	Hugh Jones	22	Pumper.	
69	William John Harding	16	Shackler.	
70	Thomas Evans	19	Rider.	
71	Robert Roberts	40	Ripper.	
72	George Evans	30	„	
73	Evan Gronow	24	Rider.	
74	Thomas Morgan	18	Door-boy.	
75	Rees Jenkins	33	Assistant ripper.	
76	Edward Jones	60	Labourer.	
77	Philip Fletcher	18	Door-boy.	
78	John Thomas	29	Haulier.	
79	Evan Morris	30	Labourer.	
80	David Price Davies	32	Timberman.	
81	Henry Charles Hooper	23	Haulier.	
82	Patrick Kahon	20	Cogman.	
83	Robert Parry	40	Ripper.	
84	George Manders	32	Haulier.	
85	Philip John Guard	18	„	
86	Benjamin Eynon	58	Shackler.	
87	Morris Lennou	24	Haulier.	
88	Alexander Addis	27	Roadman.	
89	Cornelius Gronow	36	Master haulier.	
90	John Coles	23	Haulier.	
91	Richard Jones	60	Ripper.	
92	Edward Crocombe	50	Labourer.	
93	Thomas Powell	50	Ripper.	
94	John Williams	50	„	
95	Richard James	20	Labourer.	
96	William F. Jones	49	Ripper.	
97	John Shaddock	23	Hitcher.	
98	Hugh Roberts	37	Ripper.	
99	John McGrath	23	Labourer.	
100	Levi Evans	45	Ripper.	
101	Robert Jones	25	Assistant ripper.	
102	Evan Edwards	19	Labourer.	
103	Timothy Jones	26	Ripper.	
104	Richard Thomas	20	Haulier.	
105	Frederick Leonard	35	Shackler.	
106	Samuel Taylor	20	Assistant ripper.	
107	James Colvill	21	Haulier.	
108	Richard Bowden	18	Door-boy.	
109	John Bevan	31	Timberman.	
110	William Morgan	24	Ripper.	
111	Thomas Jenkins	42	„	
112	Walter Webb	20	Labourer.	
113	George Pearce	40	Ripper.	
114	George Hunt	17	Cogman.	
115	James Hunt	49	„	
116	George Boyce	17	Door-boy.	

Nos.	Names.	Reputed Age.	Occupation.	Remarks.
117	Thomas Gittins	26	Ripper.	
118	Enoch Clarke	16	Door-boy.	
119	John Dimond	18	"	
120	Henry James	37	Ripper.	
121	Edward Bennett	50	"	
122	John Biddle	19	Collier.	
123	Daniel Jones	25	Haulier.	
124	William Evans	29	Assistant ripper.	
125	William Jones	18	Collier.	
126	Patrick Burns	20	Labourer.	
127	Walter Searle	20	"	
128	Joseph Hughes	29	Ripper.	
129	Joseph Shepherd	24	Labourer.	
130	William Humphreys	30	"	
131	Evan Jones	37	Ripper.	
132	Edward John Thomas	16	Door-boy.	
133	William Jones	31	Timberman.	
134	Thomas Rees	33	Ripper.	
135	John Jones	37	"	
136	David King	20	Door-boy.	
137	William Thomas	28	Ripper.	
138	John Morgan	38	Haulier.	
139	Thomas Powell	35	Master haulier.	
140	Adam Roberts	42	Labourer.	
141	William Price	29	"	
142	William Henry Lewis	26	Haulier.	
143	John Cox	32	Labourer.	
144	William Griffiths	24	Ripper.	
145	James Allen	35	Labourer.	
146	George Pugeley	20	"	
147	James Tickel	23	"	
148	George Freeman	17	"	
149	William Gronow	33	Master haulier.	
150	Albert Edward Thomas	25	Fitter.	
151	William Barr	29	Labourer.	
152	William David Edwards	19	Haulier.	
153	Walter Berridge	21	Assistant timberman.	
154	William Thomas	30	Haulier.	
155	Patrick Furlong	19	Labourer.	
156	John Hearne	18	Door-boy.	
157	Walter Real	21	Labourer.	
158	Stephen Downs	22	Haulier.	
159	Frederick Carp	25	Labourer.	
160	Samuel Brain	31	"	
161	William Farrow	34	"	Brought up alive; died since.
162	Walter Osborne	26	Ripper	" "
163	John Cannings	39	Engine-man.	
164	John Mears	40	Labourer.	
165	William Bates	40	"	
166	Thomas Winter	30	Shackler.	
167	Thomas Henry Harper	28	Labourer.	
168	William George	21	Ropeman.	
169	Daniel Daves	35	Labourer.	
170	Charles O'Connell	23	"	
171	Benjamin Skym	23	Fitter.	
172	Jonathan Rees	29	Ripper.	
173	John Gregory	26	Labourer.	
174	Patrick O'Donnell	21	"	
175	John Rees	38	"	
176	Richard Roberts	18	"	
177	Emanuel Gilfoyle	34	"	
178	William Chamberlain	21	"	
179	John Kings	36	"	
180	Sidney Hazel	32	Ripper.	
181	Rowland Jones	39	"	
182	Lewis Jones	24	"	
183	Frederick Saunders	21	Labourer.	
184	John Bryans	24	Haulier.	
185	William Rogers	23	"	
186	William Henry Frost	21	Labourer.	
187	John Charles Pugsley	25	Labourer.	
188	James Rowe	25	Hitcher.	
189	James Toozer	37	Labourer.	
190	Edward Rees	18	Door-boy.	

Nos.	Names.	Reputed Age.	Occupation.	Remarks.
191	Robert Smith	23	Haulier.	
192	Thomas Hughes	48	Ripper.	
193	David Owen	22	Labourer.	
194	Samuel Burgess Vile	31	,,	
195	William Hurrell	38	,,	
196	Charles A. Jones	19	,,	
197	John Edward Davies	26	,,	
198	Edward Williams	39	Ripper.	
199	John Gould	24	Labourer.	
200	James Cronin	28	Haulier.	
201	William Brown	17	Labourer.	
202	Patrick Barrett	50	,,	
203	David Owen Griffiths	17	,,	
204	John James Pingcombe	24	Assistant ripper.	
205	Humphrey Jones	39	Ripper.	
206	William Knott	53	Labourer.	
207	Peter Smith	19	Door-boy.	
208	Timothy Sullivan	47	Labourer.	
209	William Williams	23	Ripper.	
210	Albert John Davies	17	Labourer.	
211	Eli Facey	36	,,	
212	Charles Jones	25	,,	
213	David Morris	44	Timberman.	
214	William Williams	30	,,	
215	John James	30	Ripper.	
216	James Jones	27	Fireman.	
217	Reuben Heyballs	23	Labourer.	
218	Richard Gronow	26	Master haulier.	
219	George Winter	31	Haulier.	
220	Richard Davies	20		
221	Timothy Daley	17	Labourer.	
222	William Henry Pulsford	33	Ripper.	
223	David Daniel Hughes	19	Labourer.	
224	Owen Thomas	18	Door-boy.	
225	John Jones	17	Labourer.	
226	Charles Spencer	25	Assistant timberman.	
227	Frederick Weeks	22	Labourer.	
228	James Pocknell	34	,,	
229	Henry Lewis	39	Fireman.	
230	Thomas Robinson	40	Labourer.	
231	Walter John Parkman	26	Master haulier.	
232	Henry Howe	43	Ripper.	
233	William Evans	46	,,	
234	Joseph Thomas	17	Door-boy.	
235	Stephen Evans	28	Ripper.	
236	Richard Reeves	23	Labourer.	
237	Richard Evans	28	Ripper.	
238	John Griffith Roberts	39	,,	
239	David Davies	37	,,	
240	John Harris	34	Haulier.	
241	Thomas Prout	35	Ripper.	
242	Henry John Bale	23	Labourer.	
243	Richard Griffiths	26	Haulier.	
244	Isaacher Williams	49	Labourer.	
245	Richard Bluck	28	Haulier.	
246	Thomas O'Leary	17	Door-boy.	
247	Frederick Emett	19	,,	
248	Richard Roberts	36	Ripper.	
249	Thomas Jenkins	24	,,	
250	Robert Jones	40	,,	
251	John Lewis	40	,,	Brought out alive; died since.
252	George Lemon	33	,,	
253	Herbert Allard	22	Assistant timberman.	
254	Cornelius John Horrell	22	Labourer.	
255	Samuel Evans	26	Stoker	Brought out alive; died since.
256	John Evans	25	Ripper	,, ,,
257	John Lloyd	47	Labourer.	
258	James Jones	27	,,	
259	Charles Gulliford	17	Door-boy.	
260	Charles Hughes	16	Haulier.	
261	William Ware	35	,,	
262	John Rees	38	Timberman.	
263	Samuel Morgan	23	Assistant ripper.	

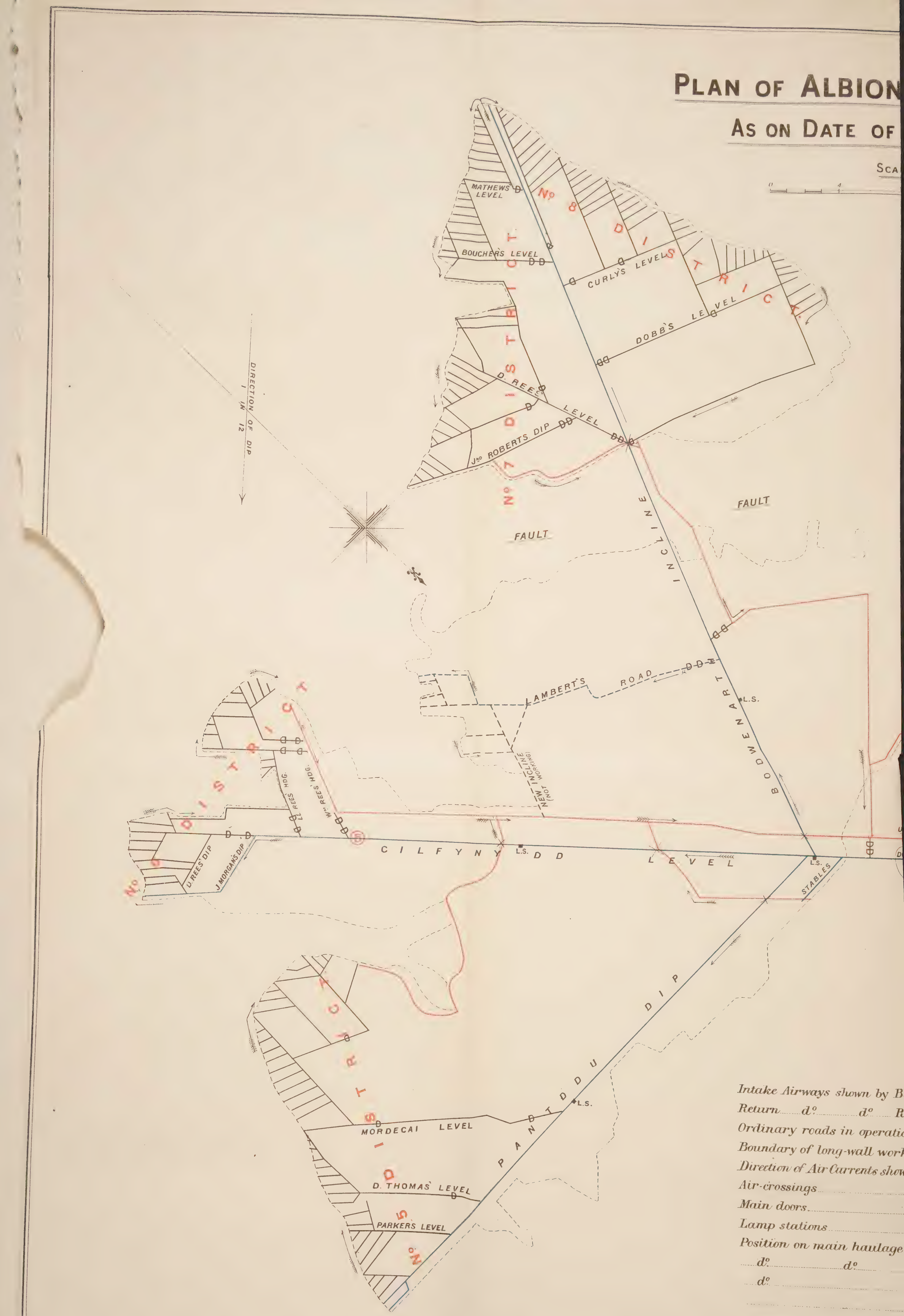
Nos.	Names.	Reputed Age.	Occupation.	Remarks.
264	Thomas Lowe	42	Ripper.	
265	Thomas Lennon	18	Haulier.	
266	David Evans	38	Fireman.	
267	Roderick Jenkins	38	Haulier.	
268	Richard Williams	25	Labourer	Brought out alive; died since.
269	Edwin Powell	35	Haulier.	
270	David Morgan	36	Ripper.	
271	John Lumley	41	,,	
272	Elias Davies	36	Timberman.	
273	William Jones	26	Labourer.	
274	James Rees	38	Ripper.	
275	William Harvey	25	Labourer.	
276	Benjamin Tucker	20	Haulier.	
277	Arthur George Willett	27	Labourer.	
278	Thomas White	21	,,	Not identified.
279	Edwin Williams	39	Ripper	,, ,,
280	David Jones	23	Ropeman	,, ,,
281	Thomas James	33	Ripper	,, ,,
282	Evan Pearce Evans	33	,,	,, ,,
283	Henry Evans	30	Timberman	,, ,,
284	John Enos Jenkins	35	Labourer	,, ,,
285	Morgan Lloyd	32	Ripper	,, ,,
286	Thomas Powell	31	Timberman	,, ,,
287	Jason Parry	23	Labourer	,, ,,
288	Thomas Murphy	24	,,	,, ,,
289	George Knight	30	,,	,, ,,
290	John Jones	26	,,	,, ,,

PLAN OF ALBION

AS ON DATE OF

SCA

0 4



Intake Airways shown by B

Return ..... d° ..... d° ..... R

Ordinary roads in operatio

Boundary of long-wall wor

Direction of Air Currents sho

Air-crossings .....

Main doors .....

Lamp stations .....

Position on main haulage

d° ..... d° .....

d° .....

OLLIERY FOUR FEET SEAM.

XPLOSION 23RD JUNE 1894.

PLAN Nº 1.

CHAINS TO AN INCH.

12 16 20 24 Chains

REFERENCE.

...us	
...º	
...y Black Lines thus	
... by faint Dotted Lines thus	
... thus	
... shown thus	
... dº	D D
... dº	L.S.
...e-parting where shots in timbers had been Fired	⑤
dº ... where dº found prepared	④
...upposed some shots which caused the Explosion had been Fired, shown thus.	⊗

I. T. Robson,
H.M. Inspector of Mines
—"—

Wyman & Sons, Ltd. Lith. 63, Carter Lane 6500

PLAN OF ALBION COLLI

AS ON DATE OF EXPLOS

SCALE 4 CHAINS TO

0 4 8 12

Coked Coal-dust on timbers.

Coked Coal-dust on timbers

Coked Coal-dust on timbers.

Coked Coal-dust on timbers & trams.

DIRECTION OF DIP 1 IN 12

MATHEWS LEVEL

BOUCHERS LEVEL

CURLYS LEVEL

DOBB'S LEVEL

D. REES' LEVEL

JNO ROBERTS DIP

No 7 DISTRICT

No 8 DISTRICT

No 4 DISTRICT

No 5 DISTRICT

No 6 DISTRICT

FAULT

FAULT

INCLINE WET

D. REES DIP

J. MORGAN'S DIP

D. REES HDG.

NEW INCLINE (NOT WORKING)

LAMBERT'S ROAD

BODWENARTH

CILFYNY LEVEL

L.S.

STABLES

UPCAST SHAFT

DOWNCAST SHAFT

ENGINE

BOILERS

DIP WET

MORDECAI LEVEL

D. THOMAS' LEVEL

PARKERS LEVEL

PANTDDU

Scorched from face here

Coal-dust timbers.

Intake Airways shown by Blue Lines thus

Return d° d° Red Lines d°

Ordinary roads in operation shown by B

Boundary of long-wall workings shown by

Air-crossings

Main doors.

Lamp stations

Position on main haulage road double-p

d° d° d°

d° where it is sup

Direction of force shown by

Falls of roof d°

The number of bodies found at different poin

Roads which were damp or wet on floor sh

ERY FOUR FEET SEAM.

ION 23RD JUNE 1894.

PLAN Nº 2.

D AN INCH.

16 20 24 Chains

FAULT

FAULT

FAULT

Nº 3 DISTRICT.

MIKE'S LEVEL

WEDGING'S HDS

SERGEANTS HDG

KEMPS HDG

Timbers scorched

DISTRICT.

OATMAN'S LEVEL

Brattice sheet burnt

SAM'S LEVEL

DANS HEADING

DUDSON'S HEADING

L.S.

STABLES

GINE

BOILER

GROVERS

HORSE PUMP DIP

L.S.

LEVEL

LLANFABON DIP

MORRIS'S DIP

MED OWEN'S DIP

Nº 1 DISTRICT.

Coked Coal-dust on timbers.

Coked Coal-dust on timbers.

Timber scorched - Coal on tram burnt.

Props thickly coated with Coked Coal-dust. Coal on tram coked.

Coked Coal-dust on timbers.

Coked Coal-dust on timbers and tram.

Coked Coal-dust on timbers.

Nº 2 DISTRICT.

WILLIAMS'S HEADING

NELSON'S HEADING

BASKET'S HEADINGS

REFERENCE.

Black Lines thus .....

Pink Dotted Lines thus .....

Faults shewn thus .....

Do Do .....

Do L.S. .....

Standing where shots in timbers had been Fired ..... (5)

Do where Do found prepared ..... (4)

Fired some shots which caused the Explosion had been Fired, shown thus. .....

Coked Arrows Do .....

Yellow colour on sides of roadways Do .....

Standing singly, or in groups, is indicated by a number thus 1 (meaning 1 body.) 5 meaning 5 Bodies) 37 (meaning 37 Bodies) &c.

Do ..... ← WET →

I. T. Robson,
H.M. Inspector of Mines
—"—

Wyman & Sons, Ltd. Lith. 63, Carter Lane 6500-10-94

No. CXI.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING AN EXPLOSION

WHICH OCCURRED AT THE

DYNAMITE FACTORY OF NOBEL'S EXPLOSIVES COMPANY (LIMITED), AT ARDEER, NEAR STEVENSTON, IN THE COUNTY OF AYR,

On January 5th, 1895;

BY

CAPTAIN J. H. THOMSON, R.A.,

H.M. INSPECTOR OF EXPLOSIVES.

Presented to both Houses of Parliament by Command of Her Majesty.

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1895.

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REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

Circumstances attending an Explosion which occurred at the Dynamite Factory of Nobel's Explosives Company (Limited), at Ardeer, near Stevenston, in the County of Ayr, on the 5th January 1895;

BY

CAPTAIN J. H. THOMSON, R.A.,

H.M. INSPECTOR OF EXPLOSIVES.

SIR, Home Office, January 31st, 1895.

I HAVE the honour to report that in obedience to your order of 14th January, made under the 66th section of the Explosives Act of 1875, I have held an inquiry into the circumstances attending an explosion (No. 5/1895) which occurred on the 5th January 1895, at the Dynamite Factory of Nobel's Explosives Company, at Ardeer, near Stevenston, in the county of Ayr, causing the death of two men and serious injury to two others.

History of the factory.

The factory was established in 1871, and commenced work in the following year. On the 15th February 1876 a continuing certificate was granted under the Explosives Act of 1875. Since that date the output of the factory has steadily increased, and additions have from time to time been authorised by amending licenses. At the present time the output of nitro-glycerine explosives at Ardeer is considerably larger than that of any other factory in the world.

Building in which explosion occurred.

The building in which the explosion occurred was designated Q 1, and was licensed as a laboratory magazine to contain miscellaneous explosives, with a proviso that it might be heated by steam pipes or other suitable means, to such an extent as might be considered necessary for experimental purposes. It was, in fact, intended and used solely for the purpose of testing the effect of long exposure to heat on various explosives. Moreover, the license does not specify that the explosives shall be only those which are licensed to be manufactured in the factory, and, inasmuch as section 45 of the Act permits of the manufacture of new explosives on a small scale exclusively for trial, it was not illegal to submit such experimental explosives to trial in this particular building. It was, therefore, recognised that there was a higher degree of risk attached to this magazine. The license limits the quantity present at any one time to 150½lbs., and provides that the building shall at all times be under the control of a competent chemist.

The building was enclosed by a substantial mound of sand, revetted with corrugated iron (*see* Appendix III.) of a considerably greater height than is insisted on for other danger buildings. It was constructed of wood with a roof of tarred felt, and measured 10 ft. 6 ins. square externally. It was fitted inside with two shelves running round three sides, and was heated with steam-pipes enclosed in wood casing.

Account of the accident.

On the day of the accident Mr. Charles Jones, chemical assistant, had as usual visited the building at 6.30 a.m., for the purpose of noting the temperature. The thermometer reading at that time was exactly 100° F., but the maximum during the previous 24 hours had been 110° F. I ascertained that the highest reading ever obtained was 125° F.

e 85890. Wt. 22966.

Mr. Jones states that he noticed nothing unusual, and that he did not have occasion to touch the steam tap which regulates the temperature. He had with him a safety-lamp.

As far as I could ascertain, no one else visited the building from that time until the breakfast hour. At 9.15 a.m., a man named John Gibson saw thick black smoke issuing from the building, and at once gave the alarm to the Factory Fire Station close by. At that time, the manager, Mr. Carl Lundholm, was absent at breakfast, and it is much to be regretted that he was not immediately sent for. However, it may easily be imagined that to the members of the fire brigade the urgency of the case seemed so great that all else was forgotten. The captain of the fire brigade was Joseph Chandler. This man had been specially selected for the post, and had undergone a training with the Glasgow Fire Brigade, where he had been imbued with all the zeal and daring of that highly efficient corps. He had no special knowledge of explosives, that being considered unnecessary for the appointment. Among the members of the fire brigade, was Mr. Robert M. Kater, who held the post of superintendent of one of the nitro-glycerine hills.* Being in this position, it was only natural that the men should defer to him to some extent; but no difficulty on the score of divided responsibility appears to have arisen, and the proceedings were directed throughout by Chandler. It is clear, however, from the presence of Mr. Kater and others experienced in explosives, that the fire brigade were in no way ignorant of the danger of the undertaking.

The men appear to have reached the building at about 9.25 a.m. At that time the smoke is described as being less dense than when first observed. There were two hydrants near the spot. A hose was attached to one of these, and was played on to the building from outside the mound for two or three minutes without any apparent effect. Chandler then went through the passage in the mound (*see* Appendix III.) to the door of the magazine. He returned immediately, and sent for his axe for the purpose of forcing the door, which was locked. At this time a man named J. Hill states that he distinctly heard a fizz like the explosion of damp gunpowder. This man then went round to the other hydrant, and attached a second hose. Coming back, he found that Chandler had prised open the door and was playing the hose on the interior of the building. Hill went also to the door and asked whether another hose was required. Chandler answered in the negative, and intimated that he considered that the fire had been got under. Hill noticed that the edge of the door was blackened all round. He could not see any fire or smoke inside the building, but he noticed a little steam.

Finding he was not required, Hill retired outside the mound. About two minutes after this, or half-an-hour from the first observation of smoke, the explosion occurred, causing the death and injury of the following persons :—

Killed :

Joseph Chandler, aged 34, Captain of the Fire Brigade.
Richard Hammond, aged 28, member of the Fire Brigade.

Injured :

Robert M. Kater, aged 46, Superintendent of nitro-glycerine factory.
James Conolly, aged 45, member of the Fire Brigade.

Immediately after the explosion several men ran up to render assistance. The injured man Conolly was able to run out without help, but was severely cut by splinters on the head and neck. The other three men were found in the positions shown in Appendix III. It would appear that Chandler had some warning and was able to step back into the passage, and that Hammond was immediately behind him. These two were blown back on to Kater, who was thrown into the corner, Chandler and Hammond being carried past him. It is not clear where Conolly was standing.

Nature of explosion.

The explosion was of great violence, as is shown by the fact that splinters of wood were driven right through the corrugated iron which formed the facing of the mound. The building was completely demolished, and the steam pipes were broken, but not shattered. Débris was projected to distances up to 110 yards to leeward. Nearly all the windows in the gun-cotton washing house, distant 25 yards, were broken, the glass falling outwards. The doors of the small laboratory magazines U^1 U^2 at about the same distance were forced open. Beyond this no damage was done.

There was little to be learnt from the appearance of the débris, as the whole had been covered by a fall of snow. There was no appearance of a crater in the ground, a circumstance which may be accounted for by the fact that the whole of the explosive

* The term "hill" is applied to each group of buildings forming in itself a nitro-glycerine factory.

present was raised, on boxes and shelves, above the floor of the building. The quantity of explosive present was 140 lbs., which was distributed in the manner shown in Appendix IV., the numbers in this plan referring to the list in Appendix I., which gives a detail of the substances contained in the magazine.

With regard to the cause of fire in the building, it is difficult to speak with certainty. Three causes present themselves as possible, or in any degree probable. These are as follows :— Possible causes.

(1.) Ignition of the roof by a spark from a chimney or locomotive.
(2.) Ignition of the woodwork by long continued proximity to the steam-pipes.
(3.) Spontaneous ignition of one or other of the explosives.

With regard to (1), the probability is very small. The only chimney near enough to drop a spark on to the building was not in use, and even if it had been, the distance is sufficient to render such an occurrence very improbable. Locomotives pass the magazine at a somewhat less distance, but there is no line of rails on the side on which the wind was blowing on the day of the accident. Moreover, it is extremely difficult to ignite tarred felt by a spark. Ignition by spark.

The second cause is one which I cannot but regard as somewhat hypothetical. The pressure of steam at the boiler was 60 lbs. to the square inch, and as the connecting pipes are over 100 yards in length, it is safe to assume that this pressure was considerably reduced before it reached the building. Moreover, there was a throttle valve outside the building by means of which the temperature was regulated. The steam, therefore, in the pipes inside the building could not have been at a much greater temperature than 212° Fahr., and the outside of the pipes would probably be at less than this figure. Ignition by proximity of wood to steam pipes.

No doubt woodwork exposed even to this temperature will, in the course of a long period, become partially carbonized, and the theory, if it may be called a theory, is that in this condition it is liable to absorb oxygen and to take fire after the manner of freshly-burnt charcoal. This absorption of oxygen, if it takes place at all, must be an exceedingly slow process, and it seems unlikely that it could develop the heat necessary for ignition. It is true that among the rules of many of the fire insurance offices, there is one to the effect that both steam and hot water pipes shall be at a certain distance from woodwork. I am, however, informed, through the courtesy of the secretaries of two of the leading insurance offices that the rule is not rigidly enforced, and that in their experience there has been no evidence of fire from this cause.

If, therefore, such a possibility exists, the conditions necessary for bringing about ignition must be of very rare occurrence.

I have ascertained that no repairs to the building had been executed during the Christmas holidays, and that no oily cotton waste was present in the building.

The third cause is, in my opinion, far the most probable. I propose, therefore, to discuss it at some length. Spontaneous ignition of explosive.

All nitro-compounds are more or less liable to decomposition by prolonged exposure to high temperature, and this liability is more marked when certain impurities are present in the ingredients, or when the acids used in the manufacture, have not been entirely removed by washing. The decomposition is attended with an evolution of heat, and if it takes place sufficiently rapidly, the heat evolved may suffice to cause ignition. In most instances the products of decomposition themselves tend to accelerate the action, which, therefore, progresses at an increasingly rapid rate. This is especially the case with impure explosives confined in such a manner that the products of decomposition cannot escape.

The method of examining explosives for purity and liability to decomposition is that known as the "heat test," and depends on the action on iodide-starch paper of the nitrous acid evolved by exposing a small quantity of the explosive to a given temperature. The measure of stability is the time which is required to produce a certain degree of discolouration of the paper.

In Appendix I. I have given the results of the heat tests previously taken at Ardeer, with the actual explosives in the building, and also those taken by our chemical adviser with samples which I procured from the same or similar batches of explosive.

The results of the heat tests taken at Ardeer, and those taken by our chemical adviser, do not in this instance agree very well. The latter, as a rule, gave shorter times, notwithstanding the fact that the temperature at which the test was taken was lower. None of the heat tests, however, indicated any notable degree of instability, and it is therefore impossible to point with any certainty to the particular explosive

which caused the ignition. The samples which gave the most indifferent results are Nos. 1^R and 14 (Australian manufacture). The latter had, however, only been in the magazine one night, and it is therefore most unlikely that decomposition could have proceeded far in that time.

The samples 1^A to 1^R had been in the building for the purposes of experiment for nearly six months, and had been exposed to heat during the whole of that period. It is to be regretted that no chemical examination was made during that time.

The object of the experiment was to ascertain what effect variation in the quality of the nitro-cotton has on the explosive when stored in hot climates. It is undoubtedly possible that the first ignition may have taken place in one of these samples, but, from the circumstances attending the fire and ultimate explosion, I do not consider it very probable. These samples (1^A to 1^R) were stored in waterproof packages in three boxes, resting on two empty boxes on the floor of the magazine. They constituted the bulk of explosive in the magazine, and it is quite certain that the final explosion was due to the contents of at least two of these boxes. If then the first ignition occurred in the third box, it is difficult to believe that half-an-hour could have elapsed before the fire was communicated to the other two, which were in contact with it.

It appears to me far more probable that one of the smaller samples on the shelves first ignited and set fire to the woodwork, and that the latter went on smouldering, owing to the limited supply of air, causing one after another of the samples to burn quietly away, until at last a burning fragment was projected on to the boxes in the middle of the building.

With regard to the explosives on the shelves, as above stated, there is no particular sample which has shown sufficient signs of instability to warrant the definite conclusion that it was the cause of the accident. I may, however, call attention to the fact that a sample similar to No. 11 (Gelignite), when exposed to heat in the Ardeer Laboratory, fell in heat test from 20 minutes to 8 minutes in three months. The liability of explosives containing wood-meal to deteriorate in hot climates is a fact to which a good deal of attention has been lately directed, and on which our chemical adviser has, at our special request, carried out a somewhat extended investigation. Indeed the experiment represented by the samples Nos. 11 and 12 had for its object the possible substitution of a material more uniform in quality and more easily purified than wood-meal.

No suspicion attaches to the samples of Ballistite and of the experimental nitro-cellulose powders, which all gave very good heat tests.

Explosive in contact with steam pipes.

There remains also the possibility of some explosive having accidentally fallen into such a position as to rest on the steam pipes. Under this condition, the most stable nitro-compound of the classes manufactured at Ardeer would suffer rapid and dangerous decomposition. This, which is recognised as an active source of danger in gun-cotton stoves, where the air is impregnated with gun-cotton dust, is scarcely a probable risk in the present instance. The pipes were cased in with wood, and the explosives were for the most part enclosed in boxes or bottles, and were not of such a nature as to form dust or to be readily spilt in the hands of careful chemists.

The steam pipes were swept from time to time, but not as frequently as would have been deemed imperative in the case of a gun-cotton stove.

Former accidents.

In Appendix II will be found a list of some of the more prominent accidents due to the spontaneous ignition of nitro-compounds. The first of these occurred at Woolwich in the early days of gun-cotton. A small brick building was maintained for about twelve months at temperatures varying between 120° F. and 130° F. during the day, and was allowed to cool down at night. Boxes containing samples of Von Lenk's gun-cotton, and also a small quantity of gun-cotton pulped in the manner suggested by Sir F. Abel, were exposed to these temperatures. Thermometers were inserted in the boxes, and each sample was removed when decomposition became apparent from the rise of temperature. This system of observation, however, did not prevent the explosion which occurred in the samples remaining after one year's exposure.

The Stowmarket explosion in 1871 was also due to spontaneous ignition, but in this case Colonel Majendie has shown in his very exhaustive report that acid had been maliciously added to the gun-cotton. The perpetrator of this diabolical crime was never discovered.

The explosions which occurred with nitro-glycerine preparations in magazines at Aden and in India have a more direct bearing on the present accident. Referring to the last of these, in our annual report for 1893 (page 53) we stated :—

"This makes, at least, the fourth instance of an explosion of a magazine from the spontaneous decomposition of blasting gelatine preparations which has come under our

notice, viz.:—the two explosions which occurred in 1888 at Aden, and the explosions which occurred in April 1890, at Shelabagh, on the Sind-Peshin Railway. Indeed, it appears to us extremely probable that two other previous explosions on the Sind-Peshin Railway (at Nari George and Kach) were due to the same cause, in which case, the explosion now under notice would constitute the sixth explosion known of this character in hot climates."

In addition to the accidents enumerated, there have been several cases of spontaneous ignition in gun-cotton stoves abroad, and numberless instances of small fires and explosions from the same cause in experimental work with explosives.

Responsibility for accident.

With regard to responsibility for the accident, I may at once say that I do not consider that any blame of a serious nature attaches to anyone.

I am satisfied that the building was being utilised only for the purposes for which it was licensed, and that the quantity contained in it did not exceed that allowed. The proviso as to the supervision of a competent chemist was also adhered to, the building being wholly in the hands of the chemical department of the factory. I feel it my duty to state, however, that in my opinion the chemical examinations of the samples under trial were not carried out at sufficiently frequent intervals.

As before stated, the fire brigade appear to have displayed great courage and coolness, and to have acted with a zeal, which, though in the present instance in excess of the requirements of the case, might under other circumstances prove of the utmost value.

While, therefore, wishing to give all credit to the deceased and injured men, for their heroism and devotion to duty, I feel it necessary to state that in the present instance an error in judgment was committed. The building which ignited was of little importance, and was so well screened that, had it been left to itself, practically no damage would have been caused beyond its own destruction. If all persons had been removed from the range of débris, the risk to life would have been entirely absent, and one cannot but deplore that valuable lives should have been sacrificed, and personal injury should have been caused in an endeavour to avert an explosion of so little consequence.

Further, it is only natural that the members of the fire brigade should have wished to support their captain in his perilous undertaking.

But there can have been no necessity for the exposure of more than one person in the present instance. It should be the invariable rule, in dealing with explosives, that where any risk has to be incurred, the number of persons exposed to the same should be as small as the necessities of the case will allow.

Prevention in future.

With regard to the prevention of similar accidents in future, Nobel's Explosives Company propose to make several alterations in re-constructing the building. The structure will be of zinc or corrugated iron, and no portion of it will be of such a character as to form a heavy missile in case of explosion. The steam pipes will be outside the building, and a drenching apparatus will be provided, by means of which water can be made to play on the interior of the magazine through valves situated outside the mound. Mr. Lundholm even hopes to be able to make this arrangement automatic, and also to provide means for observing the chemical condition of the atmosphere in the building at any time, without entering the mound inclosure.

The Company also propose to issue rules to the fire brigade, with reference to this and other unimportant buildings, to prevent them from exposing themselves to unnecessary risk.

Obviously, such rules cannot be framed as will cover every possible contingency, and much must necessarily be left to the judgment of the fire brigade captain. As before indicated, cases may arise in which prompt and courageous action on the part of the brigade may avert a serious catastrophe, and possibly large loss of life.

Undoubtedly, also, it is necessary that a strict rule should be made, that in the event of fire being discovered in any part of the factory, not only should the fire brigade be alarmed, but the manager himself should immediately be sent for.

I have the honour to be,
Sir,
Your obedient servant,
J. H. THOMSON,
Captain R.A.,
H.M. Inspector of Explosives.

APPENDIX I.

DETAILS of EXPLOSIVES present in the MAGAZINE Q 1 at the time of the EXPLOSION.

No.	Date of Manufacture.	Date of Starting.	When last examined.	Weight.	Nature of Explosive.	Heat Test on last Examination.*	Home Office Heat Test.*	Description.	
				lbs.		min.	min.		Heat Test of nitro-cotton.
1A	–.5.94	13.7.94	16.6.94	8	Blasting gelatine, No. 1.	16	13	Made with Ardeer ordinary nitro-cotton.	25 min.
1B	„	„	„	8	„	21½	15	Made with Ardeer nitro-cotton boiled with high-pressure steam.	19 „
1C	„	„	„	4	„	20	14	Made with Ardeer nitro-cotton from hard waste.	16 „
1D	„	„	„	4	„	19	12	Made with Ardeer nitro-cotton from soft waste.	27 „
1E	„	„	„	8	„	20	15	Same, but with more nitro-cotton.	„ „
1F	„	„	„	4	„	14	11.5	Made with Ardeer nitro-cotton from carded cotton.	15 „
1G	„	„	„	4	„	17	15	Made with Ardeer nitro-cotton nitrated with Krummel mixed acids.	19 „
1H	„	„	„	8	„	70	25	Made with Krummel nitro-cotton.	180 „
1I	„	„	„	4	„	14	16	Made with Pressburg nitro-cotton.	9 „
1J	„	„	„	8	„	46	25	Made with Walsrode nitro-cotton.	180 „
1K	„	„	„	4	„	30½	14	Made with Düren nitro-cotton.	58 „
1L	„	„	„	4	„	45	29	Made with Troisdorf nitro-cotton.	180 „
1M	„	„	„	4	„	20	15	Made with Stowmarket nitro-cotton.	14 „
1N	? Recent	„	„	8	„	43	19	National Explosives Company's manufacture.	
1O	„	„	„	8	Gelignite -	45	18	Do. do do.	
1P	–.5.94	„	„	8	„	48	24	Ardeer ordinary, coarse dope.	
1Q	„	„	„	8	„	20	13	Ardeer ordinary, fine dope.	
1R	„	„	„	8	Blasting gelatine with 20 per cent. potassium nitrate.	13	11	Ardeer ordinary.	
			Total -	112					
2	—	13.7.94	—	—	—	—	—	This was a box containing materials for the heat test, viz.: starch, filter paper, French chalk, iodide of potassium, and dilute glycerine.	
3	–.12.93	7.3.94	7.1.95†	½	Ballistite - -	13	30	100 sporting cartridges filled with Ballistite.	
4	„	„	—	3	„ - -	—	—	Some of the same powder in glass bottles.	
5	–.10.94	2.11.94	—	1¾	Experimental nitro-cellulose powders.	—	Over 40.	These were experimental powders, the details of which the Company do not wish published. The heat test was not taken of the finished powder, but the nitro-cellulose was selected as specially pure. They were packed in wooden boxes lined with parchment.	
6	6.11.94	23.11.94	—	¾	Do. - -	—	40	Do. do. do.	
7	6.4.94	8.10.94	7.1.95‡	2	Ballistite - -	15‡	—	Made with nitro-cottons stabilized (washed in hot water) for various times, and contained in glass bottles.	
8	27.11.92	30.11.94	9.10.94	3	Blasting gelatine -	24 to 32	—	These were two samples of blasting gelatine made with and without chalk. They were contained in packets.	
9	5.11.91	26.12.94	–.11.94	½	Gelatine dynamite -	15	—	This was three double cartridges of National Explosives Company's gelatine dynamite.	
10	6.4.94	6.8.94	7.1.95‡	1	Ballistite - -	15‡	—	This is the same powder as No. 7, but in the form of siftings.	
11	2.10.94	25.10.94	22.10.94	2	Gelignite - -	22	40	This was ordinary gelignite. Similar samples submitted to the same temperature in the laboratory went down in heat test from 20 minutes to 8 minutes in three months.	

* The Ardeer heat tests were taken at 170° F., and the Home Office ones at 160° F.
† Some of these cartridges were recovered unexploded.
‡ This was an examination of a similar sample heated concurrently in the laboratory.

No.	Date of Manufacture.	Date of Starting.	When last Examined.	Weight.	Nature of Explosive.	Heat Test on last examination.	Home Office Heat Test.	Description.
				lbs.		min.	min.	
12	2.10.94	25.10.94	22.10.94	10	Experimental gelignite.	65	24 and over 30.	These samples were for comparison with No. 10, and consisted of gelignite, in which another material was substituted for wood-meal. Similar samples heated in the laboratory went down from a mean of about 90 minutes to a mean of about 30 minutes in three months.
13	25.10.94	26.10.94	25.10.94	2	Gelignite in various stages of manufacture.	14 to 30	—	These were six samples arranged to determine whether nitrate of potash, or wood-meal, or both together, tend to lower the heat-test after exposure to high temperature. They were not tested after starting.
14	Various	4.1.95	2.11.94	1¼	Blasting gelatine, gelatine dynamite, gelignite.	27 to 8	9	These were seven double cartridges manufactured by Nobel's Explosives Company (3), National Explosives Company (1), an Australian Company (3). They had been returned from Australia, and were about to be tested for sensitiveness. They were put into the magazine on the previous day, merely for the purpose of being thawed.

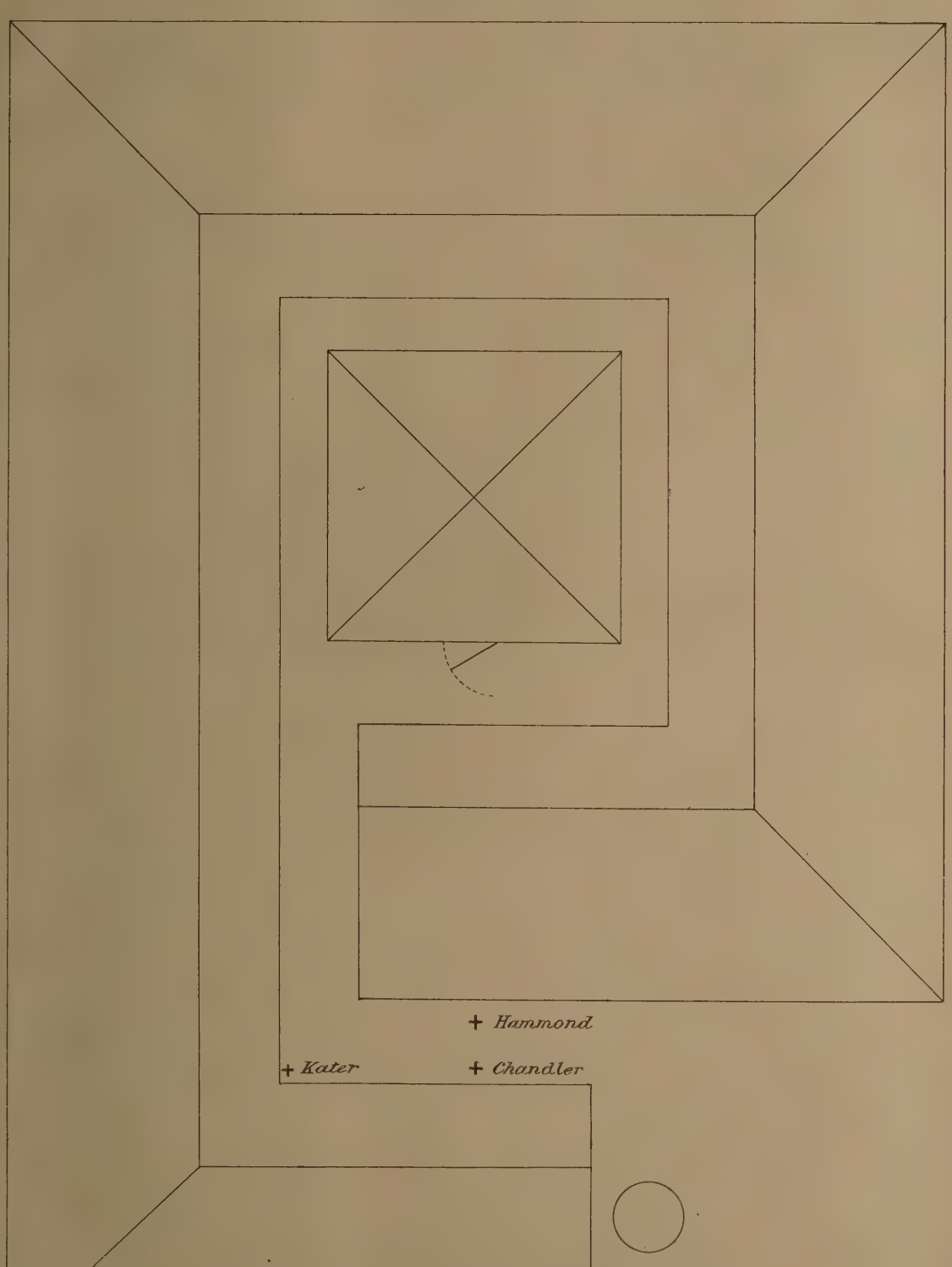
APPENDIX II.

ACCIDENTS due to SPONTANEOUS IGNITION of NITRO-COMPOUNDS.

Date.	No. of Accident.	Explosive.	Details.	Number of	
				Killed.	Injured.
1866, 1st October.	—	Gun-cotton - -	Experimental heating magazine exploded at Woolwich.	—	—
1871, 11th August.	—	Gun-cotton - -	Factory magazine at Stowmarket exploded spontaneously. Undoubtedly acid had been maliciously added to the gun-cotton.	24	50
1873, 22nd October.	22–1873	Gun-cotton - -	Gun-cotton exploded spontaneously at Cotton Powder Company's Factory at Oare.	—	2
1876, 2nd August.	27–1876	Lithofracteur - -	A few pounds of lithofracteur exposed to the sun exploded at 80, Stockwell Park Road.	—	—
11th August.	30–1876	Wood gunpowder (Xylobrome).	One ton exploded spontaneously in drying-house at Glyn Ceiriog (Fac. No. 52).	—	—
—	—	Wood gunpowder (Xylobrome).	Ship ("Great Queensland") destroyed at sea by spontaneous ignition of two tons of wood gunpowder.	69	?
1877, 12th November.	56–1877	Schultze powder.	Explosion in drying-house at Lyndhurst (Factory No. 36), possibly due to spontaneous ignition of encrustations on drying trays.	—	—
1880, 11th January.	3–1880	Fulminate of mercury -	Drying-house blew up at Westquarter (Factory No. 18). Fulminate of mercury therein contained traces of sulphuric acid, which may have caused the accident.	—	—
1888, 3rd May.	Foreign	Blasting gelatine - -	Magazine blew up at Fort Tarshyne, Aden. Due, possibly, to spontaneous ignition.	—	"

Date.	No of Accident.	Explosive.	Details.	No. of	
				Killed.	Injured.
1888, 26th June.	Foreign	Blasting gelatine -	Magazine blew up at Fort Morbut, Aden. Undoubtedly due to spontaneous ignition.	1	—
1890, April.	Do.	Ditto - -	At Shelabagh, India, a 50 lb. box of blasting gelatine ignited spontaneously in a magazine, and burnt harmlessly away without firing any of the 21½ tons of explosive surrounding it.	—	—
1891, 28th December.	Do.	Dynamite and blasting gelatine.	11½ tons in magazine exploded spontaneously at Matoonga, India.	—	—
1893, 2nd March.	—	Gun-cotton - -	Gun-cotton stove at Waltham Abbey burnt out without explosion.	—	—

Appendix III.



Plan of Magazine & Mound.

Scale 3/16" — 1 Foot.

Wyman & Sons, Ltd. Lith. 6932. 3. 95.

Appendix IV.

Position of Samples in Magazine.

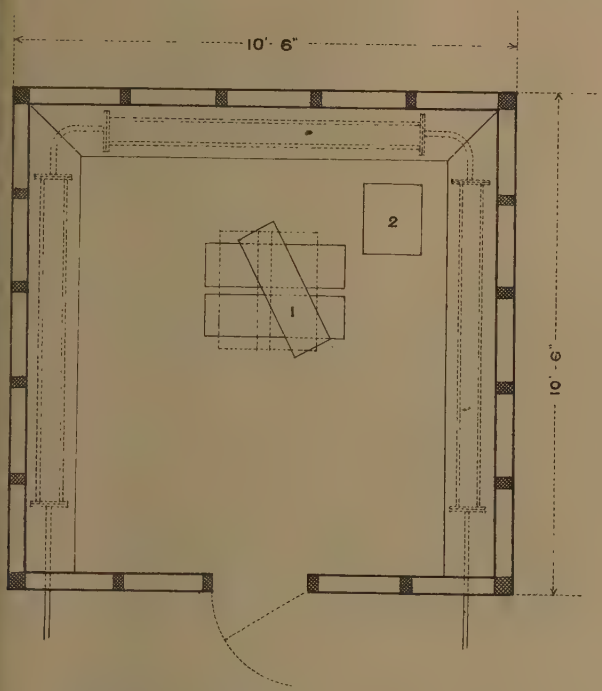


FIGURE I. GROUND LEVEL.

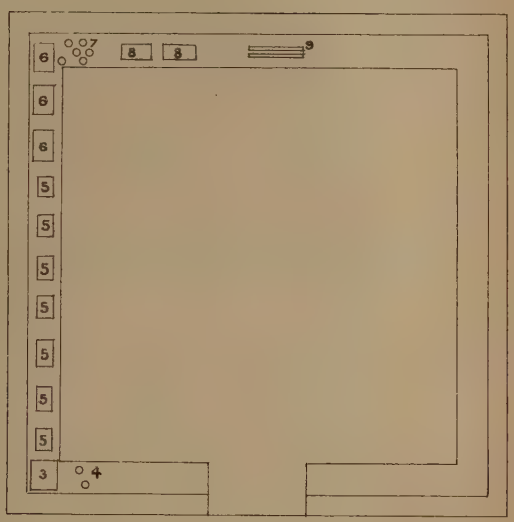


FIGURE II. FIRST SHELF

Note: The figures refer to the numbers of samples in Appendix

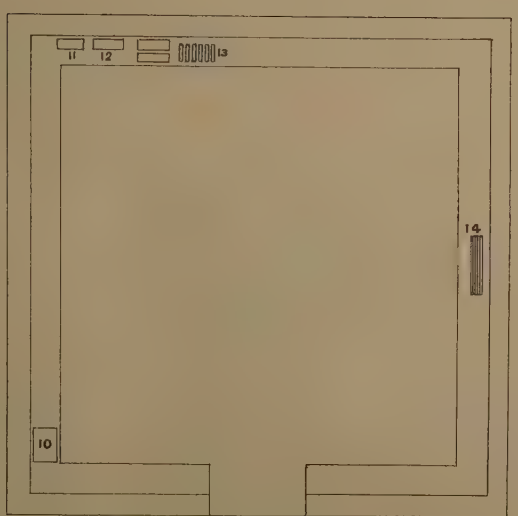


FIGURE III. SECOND SHELF.

Wyman & Sons, Ltd, Lith, 6832.3.95

No. CX.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING THE EXPLOSION

WHICH OCCURRED AT

No. 13, BLACKWELLGATE, DARLINGTON,

On the 9th October 1894;

BY

CAPTAIN J. H. THOMSON, R.A.,

HER MAJESTY'S INSPECTOR OF EXPLOSIVES.

Presented to both Houses of Parliament by Command of Her Majesty.

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REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON

The Circumstances attending the Explosion which occurred at No. 13, Blackwellgate, Darlington, on the 9th October 1894 ;

BY

CAPTAIN J. H. THOMSON, R.A.,
HER MAJESTY'S INSPECTOR OF EXPLOSIVES.

SIR, Home Office, October 25th, 1894.

I HAVE the honour to report that in obedience to your Order of 16th October, made under the 66th section of the Explosives Act of 1875, I have held an Inquiry into the circumstances attending an explosion which occurred on the 9th October 1894, at the premises of Mr. J. F. Smythe, gunmaker, at No. 13, Blackwellgate, Darlington, and which resulted in the loss of one life, and in the more or less serious injury of 10 other persons.

I also attended the adjourned inquest held by Mr. Proud, coroner for the Darlington Ward, on the 24th October.

The premises on which the accident occurred were registered for mixed explosives, and contained a room for filling small arm cartridges. Mr. Smythe appears to have carried on an extensive business in sporting cartridges, and to have been widely known in the district as a manufacturer of this class of ammunition.

Circumstances of explosion.

On the morning of the 9th of October Mr. Smythe had occasion to leave Darlington, and before starting he looked into the filling room, where his assistant, H. Anderson, and the deceased, Thomas Howe (aged 15), were engaged in filling a batch of 100 sporting cartridges with "E.C." powder. After Mr. Smythe had left, Anderson and Howe finished the cartridges and then quitted the filling room.

Anderson went out to fetch something from a neighbouring house, leaving Howe and a young man named Thomas Hines (also an assistant) in the workship. Hines was engaged in repairing a gun, and paid little attention to what Howe was doing, but he is able to state that the latter heated a ladle of lead on a small forge fire (A. Appendix I.) in the workshop and cast a lead clam.

Hines then heard the swing door of the filling room close, as though Howe had gone inside, and shortly afterwards the latter cried out to him in alarm. Turning round, Hines saw a volume of flame burst from the door of the filling room, and he remembers nothing more until he found himself buried in the débris.

Description of premises.

In Appendix I. will be found a plan of Mr. Smythe's premises. These consisted of the front shop and telephone room, which formed the ground floor of a three-storied building adjacent to the street. Behind this there was a series of one storied buildings extending back into a yard, and consisting of the office, work and store room, workshop, filling room, and cupboard for nitro-powder. The filling room was separated from the workshop by partitions of wood and glass extending up to the roof, and was entered by a swing door. The floor of this room and of the workshop was of wood not specially close-joined. This floor and the partitions which formed the filling room were constructed in February last. The only fittings in the room appear to have been a bench along one side, and the gunpowder safe, built into the wall, and raised about 18 inches above the floor. The workshop also contained a bench extending nearly the whole length of one side, and fitted with vices and tools necessary for the

repair of guns. The forge fire referred to above is shown at A, and consisted of a brick hearth and a sheet-iron hood enclosing three sides, and opening towards the office.

The position of Hines at the moment of the explosion is shown at B.

Amount of damage.

The damage caused by the explosion was very extensive, as will be seen from the plan in Appendix II. Mr. Smythe's office, store-room, and workshop were completely wrecked, while the front portion of the premises escaped with a displacement of tiles and plaster and the breaking of windows. Adjoining the workshop, and separated therefrom by a brick wall, were a packing-room and warehouse in two storeys occupied by Mr. Reed, grocer. These were also completely wrecked. The remainder of Mr. Reed's premises was considerably shaken, tiles and plaster being displaced and numerous windows broken.

On the other side of Mr. Smythe's premises there was a passage, and beyond this the office and workshop of Mr. Emerson Smith, plumber. The workshop was demolished, and the office was badly shaken. Beyond these again, and separated from the site of the explosion by Mr. Emerson Smith's workshop and by two passages, were the premises of Mr. Rodgers, blacksmith. These were also seriously shaken, and large numbers of tiles were displaced. A building at the end of the yard, distant about 50 yards from the site of the explosion, also suffered considerably, the roof being almost denuded of tiles.

Glass was broken at a distance of 400 feet, and heavy débris was projected to about the same distance. Portions of the door of the oven in which some of the nitro-powder was stored were projected to a distance of 140 feet.

The boy Thomas Howe succumbed to his injuries on October 13th. The following persons were also injured by flying débris or by the falling buildings:—

Miss Kate Symthe, daughter of Mr. J. F. Smythe,
Mr. Frank Smythe, son of Mr. J. F. Smythe,
Mr. Harry Lucas, assistant to Mr. J. F. Smythe,
} buried in the débris of the office.

Thomas Hines, mechanic, buried in the débris of workshop.

Mr. G. G. Hoskins, architect,
Mr. Emerson Smith, plumber,
} injured by débris in Mr. Emerson Smith's office.

C. Dent, apprentice, buried in débris of Mr. Emerson Smith's workshop.

Charles Hornby,
G. Ramsdale,
} buried in débris of Mr. Reed's packing-room.

Mrs. Nicholson, wife of chemist, slightly injured by shock.

I understand that one or two more persons, whose names I have not ascertained, were slightly cut by falling glass.

Quantity of explosive.

At the time of the explosion Mr. Smythe states that there were in the filling room about 2 lbs. of "E.C." powder in a 5 lb. tin, and about 40 lbs. gunpowder in the safe. In the cupboard at the end of the workshop (*see* Appendix I.) there were two 5 lb. tins of Schultze powder, one of which is stated not to have been full, one 5 lb. tin of "E.C." powder, and one 5 lb. tin of "S.S." powder. The Schultze tins were contained in an old cast-iron oven, and the remainder on shelves in the cupboard.

The buildings destroyed were all old and of light construction, and there is no reason to suppose that such quantities of explosives as are mentioned above would not be sufficient to produce the amount of damage. It is right, however, to mention that the remains of a 25 lb. tin of Schultze powder were found at some distance from the explosion. From the appearance of these it is evident that a smaller tin had exploded on the top of the 25 lb. tin, and that the latter had contained some nitro-powder, which had also exploded. Whether the quantity in this tin was large or small is not clear, but it may only have been a remnant.

Possible causes.

In the absence of any statement of the deceased, who never regained consciousness, it is impossible to arrive with any certainty at the exact cause of the accident. In such cases it is of great advantage to set out the possible causes, and then to consider the probability of each one in detail.

It is clear from the evidence that the explosion originated in the filling room, and that Howe was in the room at the moment when it occurred.

Outside causes.

We may, I think, dismiss as most improbable all outside causes, such as a spark from a neighbouring chimney, &c. The room was closed up and surrounded by the workshop, in which at the time no operation was being carried on which could tend to ignite explosive in the inner room. It is true that there was in the workshop the small forge fire above referred to, and that this fire had been used a short time before by the

deceased. But the hearth and chimney were so constructed as to render it very improbable that a spark could be carried into the inner room even when the bellows were being used.

Spontaneous combustion.

We may also dismiss as very improbable the idea of spontaneous combustion of the nitro-powder, as the manufacture of this class of explosive in this country is now, and has for some years past, been carried on with a degree of care which renders the probability of active decomposition, under ordinary conditions, very remote.

Action of the boy Howe.

It may, therefore, be safely assumed that the explosion was caused by some action of the boy Howe. I attach considerable importance to the evidence given by Thomas Hines that Howe cried out to him a moment before the accident occurred. From Hines' description of the occurrence, it would appear that there was an interval of from one to two seconds between his hearing the cry and seeing the flash. This proves that the explosion was not instantaneous and that Howe had time to see that a disaster was imminent.

That the door of the safe was not wide open is abundantly proved by its condition. It was recovered at a distance of from 40 to 50 feet from the spot on which the safe stood, and was found to be much shattered, the plates being bulged outwards and cracked. The lock was so much damaged that it was impossible to ascertain for certain whether the bolts had been shot, but the appearance (apart from other considerations to be presently mentioned) would tend to negative such a supposition. Mr. Smythe states that the safe was set slightly on a slant, so that the door tended to close itself.

These facts are consistent only with the supposition, either that the ignition was caused by the action of shutting the safe door or that it originated in the nitro-powder and spread to the safe.

Closing the safe.

With regard to the former there is no doubt that it would be possible under certain conditions to produce an explosion by the pinching of a cartridge case or loose percussion cap, accidentally dropped into a favourable position, or by the grinding of powder grains between the surfaces of iron rubbed free from paint. Neither of these causes, however, present a high degree of probability. It is inconceivable that Howe should have used the degree of force necessary to crush a cartridge or cartridge case without noticing the obstruction; whilst the possibility of the presence of a loose percussion cap in such a position is very remote. The latter cause becomes more probable if loose grains of nitro-powder had been spilt under the safe door, as these powders ignite at a lower temperature than ordinary gunpowder. But the evidence of Anderson, the assistant who looked after the powders, was to the effect that the safe door always worked easily and that there was no appearance of the rubbing away of paint.

Moreover, the nature of the injuries to the deceased were not such as to lead to the supposition that he was in the act of closing the safe door, nor indeed that he was very near the safe at the moment of the explosion. Neither is it likely that, had this been the true cause, Howe would have had time to call out before the explosion occurred. In view therefore of more probable causes these may, I think, be dismissed.

Smoking and lights.

There are several possible ways in which the powder outside the safe may have been ignited. The evidence goes to show that Howe was not smoking when he entered the filling room and that he did not take a naked light into the room; indeed, there was no reason why he should have done so, and there were strict orders to the contrary. These causes may therefore be dismissed.

Filling cartridges.

Again it is very improbable that Howe was engaged in filling cartridges at the moment of the accident. He had no order to do so, and had, as far as I could learn, never carried out this operation by himself. When assisting Anderson he was in the habit of filling the wad boards and shotting cartridges, but never of using the filling machine. Moreover, if the accident had been caused by the explosion of a cartridge, Hines would undoubtedly have heard the initial report.

Fall of filled cartridge.

The latter argument disposes of the supposition that a filled cartridge was exploded by a fall. Such an occurrence is very rare, but by no means impossible, as is shown by the record of several explosions from this cause given in Appendix B. of the official treatise on Military Breech-Loading Rifles, 1869. Since that date a "safety anvil" has been introduced into the caps for military cartridges, but difficulties in connexion with the variations in guns of different manufacture have prevented the use of this anvil in sporting ammunition.

Carrying fire in clothes.

Another possible, though not very probable, cause would be the carrying of fire from the forge in Howe's clothing. In a gunpowder factory the possibility of this has more

than once been shown; but in such cases the clothing would be more or less impregnated with gunpowder dust, and such an occurrence is extremely improbable with ordinary clothing.

Match. A match may have fallen from Howe's pocket in the act of stooping down. Improbable as it may seem, experience goes to show that even persons careful in other respects will at times unconsciously bring matches into buildings in which explosives are used, and that loose matches are liable to fall out of a man's pocket on to the floor. That Howe was an occasional smoker is shown by the fact that an empty cigarette case was found in his pocket. No matches, however, were found in his clothing, nor was there any trace that such had been there. Mr. Smythe had given strict orders against the introduction of matches in the filling room and these orders appear to have been fully understood by his other assistants. While, therefore, admitting the possibility of this cause I do not consider it by any means the most probable.

Exposed iron. Again, Howe was wearing ordinary boots with iron nails and iron shod heels. As no precautions were taken against its introduction, there must also have been grit on the floor brought in from outside every time the room was entered. Moreover, the nails in the floor itself were of iron, and even in a new floor some of these would be liable to project. It is only necessary to observe a person walking along an ordinary road at night to realise that sparks produced by the contact of iron nails with grit are not of rare but of constant occurrence. Indeed, the old flint lock on a musket was simply an arrangement to utilise such sparks for the ignition of gunpowder. Similarly sparks may be produced by the contact of iron on iron. On the floor of a filling room, unfortunately, it is impossible altogether to avoid the presence of loose grains of powder, and these grains will accumulate in the cracks of the boards in quantities which the most careful sweeping will fail to remove. These accumulations of powder would in fact form trains which when ignited might carry the flash across the floor to the safe. This theory presents the difficulty that it does not account for Howe's presence in the room, and that in order that the contents of the safe should have been ignited, the flash would have had to leap up to the height of 18 inches at which the safe stood above the floor. With regard to the former difficulty it is necessary to suppose that Howe entered the room for the purpose of sweeping it out or tidying up. As regards the ignition of the contents of the safe this presents a difficulty whatever may be the theory of the cause of the explosion. Undoubtedly the safe door must have stood ajar, otherwise it is inconceivable that the flash could have reached its contents and there must have been grains of powder spilt in its interior. Probably also the accumulations of spilt grains of powder on the floor were greater immediately in front of the safe door.

Boyish experiments. There is one other cause which presents in my opinion a higher degree of probability than the last mentioned. In the pocket of the deceased was found portions of a toy pistol. These, in themselves, could not possibly have tended to cause the explosion, but the fact is significant as showing that Howe had the tastes and inclinations common in boys of his age. Moreover, I learned from the occupier of the premises adjoining Mr. Smythe's that what this gentleman described as "squibs" were frequently let off by persons in Mr. Smythe's employment; and that my informant had, on more than one occasion, remarked to his customers, "They will be blowing us up one of these days." These so-called "squibs" were probably small quantities of loose gunpowder or nitro-compound, and may have been burnt "for fun" or for the purpose of destroying waste powder. If done at a safe distance from all other explosive this practice, though objectionable and no doubt unknown to Mr. Smythe, is not necessarily a source of danger. The above facts, however, have led me to the conclusion that it is by no means improbable that Howe, taking advantage of Anderson's absence, went into the filling room for the purpose of carrying out some boyish experiment in connexion with explosives. What this experiment was it would be impossible to conjecture. He may have been engaged in breaking up a cartridge for the purpose of extracting the powder, or it may have had some relation to the toy pistol above mentioned. Again, the experiment may have involved the burning of a small quantity of powder on the bench, in which case a hot iron taken from the forge fire would have been the most probable means of ignition. There is some reason for supposing that Howe had opened the safe door and left it ajar, as the evidence goes to show that the safe was properly closed, but not locked on the previous evening, and that it had not been opened by Anderson on the morning of the explosion.

Most probable cause. These considerations have led me to the conclusion that the most probable cause of the accident is one or other of the two last mentioned. Neither of these causes is without precedent. The ignition of powder grains on the floor by a spark from

exposed iron has unfortunately been only too frequently the cause of accident. I may mention as an example a disaster which occurred at Messrs. Bickford Smith's factory for safety fuze in Cornwall some years ago (No. 6/1872). On this occasion one of the rooms had been swept out and cleared of powder, and the machinery was under repair. A bar of iron fell and struck the foot of a machine, causing a spark, which ignited grains of powder collected in the joints of the flooring. The flame was seen to travel along the whole length of the room and to ignite coils of safety fuze at the end of the building. Eight girls were suffocated by fumes from the burning fuze. Other accidents of the kind have occurred both before and after this date, but in no case was the evidence as to the cause so clear and convincing as in the one referred to.

Accidents from the experimenting or playing with gunpowder by boys have also not been uncommon. As an instance I may quote an explosion which occurred at Cradley Heath on 7th April 1887, when a considerable quantity of gunpowder was fired by some children who were igniting small quantities in the neighbourhood of the place where the gunpowder was stored (Special Report LXXVII.).

Offences against the Act.

From the evidence of Mr. Smythe and others it is clear that the provisions of the Explosives Act, 1875, were not adhered to, and that several illegalities had been and were being committed on the premises. Some of these have direct bearing on the accident, and it is necessary that I should deal with them in detail.

Gunpowder stored in filling room

Section 46 of the Act provides that the occupier of registered premises shall not be guilty of illegal manufacture of explosives if he fills small arm cartridges, provided that he observe certain regulations. The first of these regulations is that "there shall "not be in the room in which such filling is carried on more than five pounds of gun- "powder, or the prescribed amount of any other explosive, except it is made up into "safety cartridges."

Mr. Smythe appears to have been aware of this regulation, and to have considered that it would not be taken to include the contents of a safe built into the wall of the room and opening into it. In this he was undoubtedly wrong. He states, however, that he placed the safe in this locality in order to avoid what he considered to be a risk in the carrying of powder to and from the filling room. It is needless to point out that if the safe and its contents had been absent, the explosion would have been of a far less serious character.

Notice of use of filling room omitted.

The fifth regulation in section 46 is that the occupier shall give notice " . . . in the "case of a store or registered premises, to the local authority that he intends to carry "on such filling of cartridges." No such notice was given. The object of this regulation is, of course, that the filling room should be subject to regular inspection by the officer of the local authority. In the present instance the officer states that he was unaware that Mr. Smythe was in the habit of using a filling room.

I may mention, however, that in the register kept by the magistrate's clerk the entry against Mr. Smythe's name was to the effect that a filling room was in use, but the book also indicated that such room was in use in the case of every registered premises in the town, which, as a matter of fact, in several cases it was not. Clearly, therefore, no attention had been paid to the matter by the local authority.

Section 40 (sub-section 2) of the Act provides for the making of general rules to be observed in registered premises, and these rules form the subject of Orders in Council Nos. 7, 7*a*, and 7*b* made under the above section.

Exposure of iron in receptacle.

In the first of these Orders it is laid down that the interior of a receptacle used for the keeping of explosive shall be so constructed or so lined and covered as to prevent the exposure of any iron or steel. The oven in which the nitro-powder was kept was not so constructed or lined. Though this offence has no direct bearing on the accident, I would point out that even if efficiently lined the oven was eminently unsuited as a receptacle for nitro-powder, as, owing to the resistance it offers, it is calculated to develop the full violence of this otherwise slow burning class of explosive.

Excess.

Order in Council No. 7*b* lays down the amount of explosive which may be kept in registered premises. Two modes of keeping are provided, but it is only necessary here to deal with mode B., under which explosive was kept in the present instance. The quantity allowed in this mode is, in addition to safety cartridges, 25 lbs. of small arm nitro-compound, or in lieu of every pound not so kept, 4 lbs. of gun-powder in a fireproof safe. On Mr. Smythe's premises, according to the evidence there were about 20 lbs. of nitro-compound and about 40 lbs. of gunpowder in the safe. There was, therefore, an excess of 20 lbs. of gunpowder. That this was not an exceptional state of things is proved by Mr. Smythe's own statement that he ordered 25 lbs. of nitro-powder and 75 lbs. of gunpowder, the two orders being

given within a few days of each other. He was evidently under the impression that he was allowed to keep 100 lbs. in all.

Obviously if the excess had not been present, the extent of damage and consequently the number of persons injured would have been greatly diminished, but at the same time it is only right to point out that had no nitro-compound been present, Mr. Smythe would have been entitled to keep 100 lbs. of gunpowder in the safe, and the effects produced by the explosion of this quantity (if such had occurred) would not have differed greatly from those which were actually produced.

Breaking bulk.

Section 22 (sub-section 5) of the Act lays down that "all gunpowder exceeding one "pound in amount shall be kept in a substantial case, bag, canister or other receptacle "made and closed so as to prevent the gunpowder from escaping." By section 39 this rule is made to apply to all other explosives. The effect of this provision is to render it illegal to open on the premises any package containing more than 1 lb. of gunpowder or of small arm nitro-compound. The presence of the 25 lb. tin above referred to proves that this rule has not been observed, and Mr. Smythe admits that on more than one occasion these large tins have been opened on the premises and their contents transferred to smaller receptacles.

The practice of breaking bulk is, I regret to say, one which is still not always strictly prohibited by local authorities, notwithstanding that we have repeatedly called attention in our Annual Reports to the necessity of enforcing the provisions of the rule above referred to.

There is no difficulty whatever in obtaining gunpowder or other explosives in packages of 1 lb. as required by the Act, and unless a person intends to sell larger packages whole and intact, he must arrange with the manufacturers who supply him for them to deliver only such 1 lb. packages.

Due precautions not taken.

The Explosives Act (section 23) further requires that the occupier of registered premises "shall take all due precautions for the prevention of accidents by fire or explosion in the same." This provision is of special importance in connexion with the use of a filling room. The operation of filling cartridges is one attended with a certain amount of risk, and the Act requires that the occupier, as well as every person employed by him shall do all in their power to minimise this risk. Mr. Smythe appears to have been to some extent alive to his responsibilities in this respect, but there was nevertheless an absence of certain precautions which are considered as elementary in factories for explosives.

The first and most obvious of these is to prevent the introduction of matches into the filling room. I understand that orders were given that neither lights nor matches should be taken into the room, but, as above indicated, experience shows that unless some system of searching is carried out, it is impossible to prevent such orders from being consciously or unconsciously disobeyed. It is clearly the duty, therefore, of the occupier to satisfy himself by actual search from time to time that the order is not forgotten or neglected. Further, as pointed out above, there is danger in the presence of grit on the floor, and of nails in boots, in any place where grains of powder are liable to be spilt. The danger can be almost entirely averted with little difficulty by the use of overshoes of felt, indiarubber, or leather (without nails), or by insisting on boots being removed on entering the filling room. If overshoes are used, these should be kept inside the room, and persons should never be allowed to cross the threshold without putting them on when the operation of filling is in progress or about to be commenced. If the room is used for other purposes in the intervals of filling, it should be carefully swept out before that operation is commenced, and also at the conclusion of the day's work, to remove all spilt powder. In fact, a high standard of cleanliness should be most rigidly enforced. A floor cloth of linoleum or other similar material will enable this removal of spilt explosives to be done with greater ease and efficiency, and will also prevent the accumulation of powder grains in the openings of the boards. The sweeping appears to have been properly attended to in the present instance.

Iron and steel implements should, as far as possible, be excluded from the room, or, at any rate, from the neighbourhood of the table on which the filling is carried out. Boys under the age of 16 should on no account be allowed to enter or be present in the filling room alone when explosive is present, nor should they have access to the receptacles in which the powder is kept; indeed, such receptacles should invariably be kept locked, and the key should be in the possession of the occupier himself, or of some person to whom he can entrust it. Unless this is done the requirement of section 23, that the occupier shall take all due precaution for preventing

unauthorised persons having access to the powder, cannot be considered to have been adequately fulfilled.

If the provisions of the Act are strictly adhered to, and if the above precautions are taken, the danger of serious explosion in connexion with the filling of small arm cartridges may be regarded as very small indeed. Otherwise the risk remains of a distinctly appreciable character. It is only fair to Mr. Smythe to say that he has been so far impressed by the importance of taking more adequate precautions for the future, and of conforming strictly with the provisions of the Act, that he has already taken steps for the erection of a store and filling room outside the town, and has taken great pains to acquaint himself with the law in regard to such buildings.

Inefficient inspection.

While therefore a considerable degree of blame attaches itself to Mr. Smythe for infringements of the Act and for neglect of certain precautions, I feel it my duty to express an opinion that the system of inspection as carried out by the officer appointed by the local authority has been very inefficient.

By the Local Government Act, 1888 (section 39), the administration of the Explosives Act in municipal boroughs which are neither county nor quarter sessional boroughs falls to the county council, which, by section 28 of the same Act, has power to delegate its authority to the justices in petty sessions or to district councils. The latter, by section 100, include urban and rural sanitary authorities. In the case of Darlington, which is neither a county nor a quarter sessional borough, the county council have delegated the administration of the Explosives Act to the justices in petty sessions, and they have, as is usual, appointed as inspecting officer the superintendent of police.

This officer, however, appears to have carried out his duties in a perfunctory manner. I have ascertained that Mr. Smythe's premises had not been inspected for 12 months. It would, of course, be impossible to lay down any rules as to how often registered premises should be inspected; this must depend to a great extent upon circumstances. But I am strongly of opinion that where the occupier of premises is in a large way of business, or where there is reason to suppose that illegal practices are carried on, inspections should be much more frequent. This is especially necessary during the shooting season in the case of persons who make up sporting cartridges.

It is true that Mr. Smythe had omitted to give notice of the use of a filling room, but it is the duty of the officer to see that the provisions of the Act are adhered to, and it certainly requires no high degree of intelligence to arrive at the conclusion that a gunmaker carrying on so large a business was in all probability—I might perhaps say certainty—in the habit of filling cartridges. At any rate no inquiry appears to have been made as to whether or not this was being done, and the inspecting officer expressed himself quite ignorant of the existence and use of a filling room on Mr. Smythe's premises.

It would, however, appear that this officer was almost the only man in the town, or indeed in the district, who was ignorant of the fact, and his ignorance is the more remarkable in that "Smythe's cartridges" have been largely advertised in local papers, and that, moreover, Mr. Smythe had actually filled cartridges for the officer himself.

Again, no steps had been taken to acquaint persons who registered their premises with the requirements of the Act. It may be urged that this is not the duty of the local authority or of its officer, and that ignorance of the law is no excuse for offences against it. This is, of course, perfectly true, but it is equally certain that an intricate Act can never be really effectively administered unless some attempt is made to acquaint those concerned with the nature of its provisions. If the inspecting officer had possessed one particle of zeal, he would at any rate have taken some steps in this direction.

With regard to this point I may mention that summaries of the provisions of the Act with regard to premises registered for gunpowder and also for mixed explosives have been prepared by this Department, and may be obtained through any bookseller at a merely nominal price. These should, in my opinion, be either distributed to or placed within the reach of occupiers of registered premises by every local authority in the kingdom.

Where inspection by the officer of the local authority is not carried out at all, or is carried out in a perfunctory manner, as in the present instance, the Explosives Act must tend to become a dead letter. Occupiers of registered premises will come to regard their responsibilities as merely nominal, and even those who are most willing and anxious to conform to the Act, will be disheartened at finding that their rivals in the

trade are allowed to disregard every regulation. As a consequence of this state of things the danger to life and property in a populous town may become very considerable, and this danger is the more subtle in that no householder can be assured that his neighbour who keeps explosive takes even the most simple precautions to avoid a disaster.

To sum up, I consider that the results of my inquiry show—

(1.) That the accident was most probably due to one or other of the two causes mentioned on p. 6.

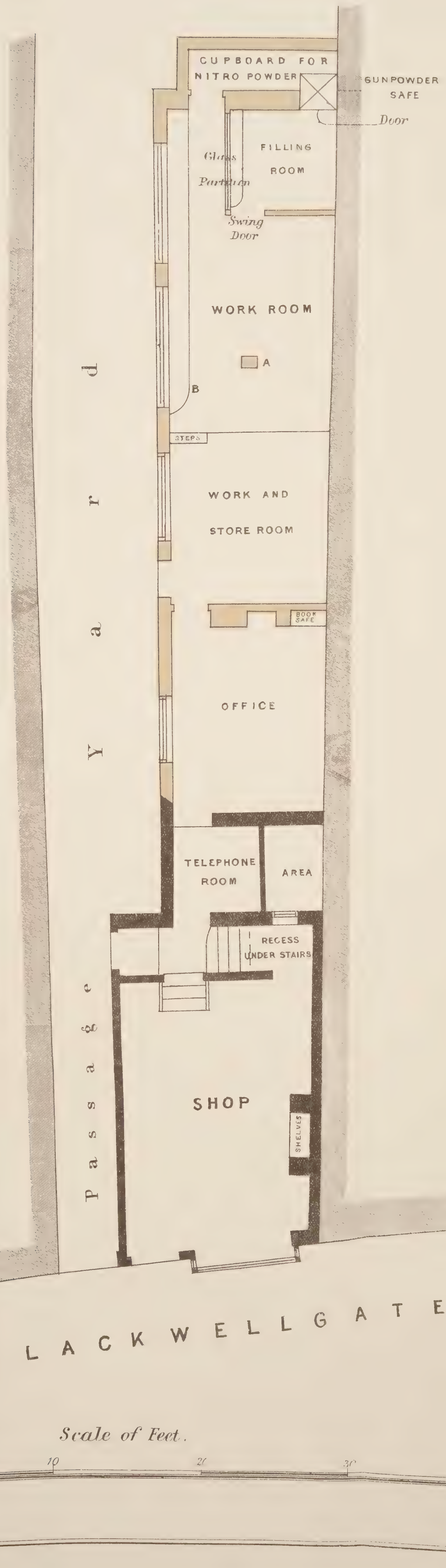
(2.) That several offences against the Explosives Act had been and were being committed on the premises.

(3,) That the administration of the Act by the local authority was very far from being efficient.

I have the honour to be,
Sir,
Your obedient Servant,

J. H. THOMSON, Captain, R.A.,
H.M. Inspector of Explosives.

Ground Plan of
Mr Smythe's Premises
Blackwellgate, Darlington.



Note:—

The light tint shews the buildings entirely blown down.

The roof and the top part of telephone room are blown down.

Scale of Feet.

10 5 0 10 20 30 40 Ft.

W.J. Arguiller,
Surveyor.
Darlington.
October 20th 1911.

Wyman & Sons Ltd. Lith. 63, Carter Lane 8616

APPENDIX

BOROUGH OF DA

PLAN SHOWING THE LOCALITY OF

BLACKWELL

TUBWELL ROW

COVERED MARKET

TOWN HALL

HORSEMARKET.

H I G H R O W.

PROVINCIAL BANK

POST HOUSE WYND

MECHANICS YARD

47 Yards

52 Yards

Iron Oven

114 Yards

104 Yards

MECHAN

INSTIT

S K I N N E R G

Note:- 50 Yards along th
a piece of Timber fell

Timber weighing 15 lb.

136 Yds. referred to in above Note

Scale 44 feet to an Inch

Borough Surveyor's Office
October 1894.

II.

RLINGTON.

THE GUNPOWDER EXPLOSION.

GATE.

REFERENCE

O *Where Explosion occurred.*

X *Shop Windows Damaged by Explosion.*

Red shading shews Buildings completely wrecked.

Blue do. shews do. severely shaken.

X *Black crosses shew positions where heavy débris fell.*

CHANCERY LANE

FLEECE HOTEL

BLACKWELL GATE

40 Yards

× 2 pieces of Gunpowder Safe

MAJESTIC P.H.

63 Yards

THREE BLUE BELLS INN

HOLBORN GATE

ARDEN ST

COUNTY HOTEL

GRANGE RD

IMPERIAL HOTEL

CONISCLIFFE RD

A T E

ne
aking Slates

Wyman & Sons, Ltd. Lith, 63 Carter Lane. 6616. II 94.

APPENDIX III.

Accidents on Registered Premises which have occurred since the Explosives Act, 1875, came into force.

Date.	No. of Accident.	Place.	Details.	Number of	
				Killed.	Injured.
29 June 1876	25—1876	Bishop Auckland Co-operative Stores.	Fire involving gunpowder, which exploded.	—	—
14 Nov. 1876	54—1876	Pemberton, Wigan.	Boy was getting powder for a customer by candlelight, when explosion occurred.	1	—
17 April 1877	11—1877	R. P. of Messrs. Chew, Stroud.	Gunpowder stored in attic fired by jackdaw's nest being set alight by sparks from an adjacent chimney.	—	—
29 July 1877	38—1877	R. P. of Messrs. Braddell, Castle Place, Belfast.	Fire involving gunpowder in an unlocked safe, which exploded.	—	—
18 July 1877	50—1877	R. P. of Mr. Adkins, Bedford.	In turning down a pin cartridge the workperson appears to have placed it improperly in the machine.	—	1
28 July 1877	45—1877	Do. do.	Explosion during cartridge filling. (Inquiry and Special Report, No. X.)	2	—
25 Jan. 1878	3—1878	R. P. of Mr. Jackson, Skelmersdale.	Boy dropped a lighted candlewick into an open powder keg which was in the shop.	1	2
6 Nov. 1878	70—1878	R. P. of Mr. Jacobs, Newport, Mon.	Stock of fireworks ignited by a cracker being fired off in the shop.	—	1
2 Nov. 1878	71—1878	R. P. of Mr. Gill, Middleton.	Man lit gas and threw the match amongst some exposed fireworks, which ignited.	—	—
15 Oct. 1878	75—1878	R. P. of Messrs. Hart and White, Colchester.	Assistant struck base of central fire cartridge with a corkscrew. ¼ lb. gunpowder ignited by ensuing explosion.	—	1
25 Jan. 1879	8—1879	R. P. of Mr. Crozier, Ballinamallard.	Match head dropped into gunpowder drawer.	—	1
2 Aug. 1879	89—1879	R. P. of Messrs. Wright and Whitworth, Crook, Durham.	Spilt powder on stone floor ignited and fired 7 lbs. of gunpowder in a box close by.	—	2
10 Sept. 1879	123—1879	R. P. of Mr. Marsh, Walworth, S.E.	Child got some Roman candles out of shop and threw them on the fire in the sitting-room.	—	2
28 May 1879	152—1879	R. P. of Mr. Jones, Islington, N.	20 lbs. of coloured fire exploded in tin box in basement, probably by spontaneous combustion.	—	1
3 Jan. 1880	2—1880	R. P. of Mr. Hanson, Doncaster.	Fire involving gunpowder in attic. A second explosion occurred shortly after the first. A Milner's safe, bolted, but not locked, fell to the ground from the attic, and, bursting open, exploded. (Inquiry and Special Report, No. XXIX.)	3	2
24 June 1880	54—1880	R. P. of Mr. Hamilton, Larne, Antrim.	Fire involving 11 or 12 lbs. of gunpowder.	—	—
22 July 1880	63—1880	25, South Castle Street, Liverpool.	A boy accidentally fired a pin-fire cartridge in turning it down.	—	1
27 Aug. 1880	74—1880	R. P. of Mr. Bennett, Birmingham.	Illegally drying coloured stars, which ignited.	—	1
5 Nov. 1880	94—1880	R. P. of Mr. Dalton, Newport, Mon.	Lighted cracker thrown into shop ignited some fireworks in a case on the counter, open at the moment for the inspection of a customer.	—	—
11 May 1881	44—1881	R. P. of Messrs. Cadle and Blakeborough, Stockton-on-Tees.	Explosion of a cartridge whilst being wadded, communicating to ½ lb. of loose powder.	—	1
27 Sept. 1881	91—1881	R. P. of Mr. Cullen, Deal.	Fire involving 30 lbs. of gunpowder.	—	1
8 Oct. 1881	92—1881	R. P. of Mr. Everard, Athlone.	Man pushed tin box of gunpowder along the floor with his foot, thus igniting a match, which caused the explosion.	—	1
27 Aug. 1882	83—1882	R. P. of Mr. Smith, St. Albans.	Fire involving small quantity of gunpowder.	—	—
7 Sept. 1882	88—1882	R. P. of Mr. Bradley, Moss Side, Manchester.	Boy entering garret where powder was kept dropped a lighted match on the floor and ignited scattered grains of powder, communicating explosion to contents of a barrel.	—	3
27 Nov. 1882	130—1882	R. P. of Margaret Wilson, Cambusnaethan.	Girl lit gas and threw burning paper away. It fell into a tin of gunpowder.	—	—
18 Oct. 1883	147—1883	R. P. of Mr. Clemens, Hanley, Staffordshire.	Loose gunpowder, illegally kept in a drawer, exploded.	—	2
29 Oct. 1884	115—1884	R. P. of Messrs. Watson & Co., Hackin's Hey, Liverpool.	Boy lit with a match some gunpowder sweepings on the floor. Flash communicated with about ½ lb. of gunpowder in a bag.	—	1
5 Nov. 1884	120—1884	R. P. of Mrs. Allen, Handsworth, Sheffield.	Fireworks exposed under a gas-jet lit by spark from a match.	—	—
25 Oct. 1884	124—1884	R. P. of Mr. Piggott, Seven Sisters Road, N.	Fire (started by ignition of benzoline) involving 12 lbs. of gunpowder.	—	—
18 Jan. 1885	3—1885	R. P. of Mr. Stribling, Colnbrook, Bucks.	Boy dropped a match into an old biscuit tin containing ½ lb. of damaged gunpowder. He died from syncope shortly after explosion.	1	1

Date.	No. of Accident.	Place.	Details.	Number of	
				Killed.	Injured.
8 Aug. 1885	80—1885	R. P. of Mr. Cleland, Clerkenwell.	Fire (started by benzoline) involving ¼ lb. of gunpowder. Boy killed by falling into cellar of shop.	1	—
4 Sept. 1885	90—1885	R. P. of Mr. Reilly, 277, Oxford Street, London.	Boy got hold of "garden alarm," and tried to open it.	—	1
5 Nov. 1885	111—1885	Anfield, Liverpool -	Boy threw a lighted firework into shop while gunpowder was being served.	—	Several
14 April 1886	41—1886	R. P. of Mr. Baker, 88, Fleet Street, London, E.C.	During unmaking of small arm cartridges a pin-fire cartridge exploded, firing ½ lb. of loose gunpowder.	—	2
12 Sept. 1886	91—1886	R. P. of Co-operative Society, Muirkirk, Ayr, N.B.	Boy lit some spilt gunpowder - -	—	1
28 Sept. 1886	94—1886	R. P. of Mr. Grove, St. Philip's, Sheffield.	Child killed by the ignition of coloured fires illegally made by his father.	1	1
31 Oct. 1886	113—1886	R. P. of Mrs. Blake, Queen's Road, Peckham.	Spontaneous ignition of coloured fires amongst other fireworks.	—	—
10 Nov. 1886	117—1886	R. P. of Mr. Strafford, Barnsley.	Fireworks exploded through the overheating of a stove in an adjoining room.	—	—
7 April 1887	28—1887	R. P. of Mr. Mold, Cradley Heath, Stafford.	200 lbs. of gunpowder illegally stored ignited by a flash from some gunpowder with which children were playing close by. (Inquiry and Special Report, LXXVII.)	4	2
14 July 1887	69—1887	R. P. of Mr. James, Brynmawr, Brecon.	Shopman struck a match to look for gunpowder under the counter. An explosion ensued.	—	1
3 Nov. 1887	107—1887	R. P. of Mr. Henry, Edinburgh.	Man injured by explosion of some cartridges which he was illegally breaking up.	—	1
13 April 1888	34—1888	R. P. of Mr. Campbell, Broxburn.	Child threw a lighted match on to cartridges which were being conveyed from safe in the garden.	—	6
1 May 1888	42—1888	R. P. of Mr. Horner, Limavady.	Explosion of 75 lbs. of gunpowder which assistant was getting out. No cause assigned.	—	1
3 Jan. 1889	1—1889	R. P. of Mr. Cameron, Ballymena, Co. Antrim.	Assistant lit a match near a tin containing 1 lb. of gunpowder, causing an explosion.	—	1
1 June 1889	58—1889	R. P. of Mr. Grundy, Little Halton, near Farnworth.	An explosion followed the lighting of a match near an open canister containing less than 1 lb.	—	1
14 Oct. 1889	94—1889	R. P. of Mr. Ramsbottom, Manchester.	Fire involving fireworks. - - -	—	—
23 Nov. 1889	19—1889	R. P. of Messrs. Aitken, Grangemouth.	Fire involving 75 lbs. of gunpowder illegally kept.	1	Several
2 Sept. 1890	87—1890	R. P. of Mr. Argles, 143, Queen Victoria Street, E.C.	Explosion during illegal unmaking of cartridges.	—	1
19 Dec. 1890	114—1890	R. P. of Mr. Wilton. -	Fire involving 15 lbs. of gunpowder. -	—	—
19 Jan. 1891	9—1891	R. P. of Mr. Hunter, Bellshill.	4 lbs. gunpowder in an open barrel kept illegally in shop ignited by a spark from a candle.	1	4
28 Oct. 1891	111—1891	R. P. of Mr. Wood, Oldham	Fireworks loose on shelves ignited by a match struck near them.	1	—
31 Oct. 1891	112—1891	R. P. of Messrs. Ware Brothers, Coventry.	Do. do. -	—	—
3 Dec. 1891	128—1891	R. P. of Mr. Tannock, Catrine, Ayr, N.B.	Fire involving 1 lb. gunpowder kept in shop.	1	2
21 Jan. 1892	8—1892	R. P. of Mr. Evans, Aspull, near Wigan.	Match struck whilst powder being emptied from a keg into a tin box.	—	2
7 March 1892	26—1892	R. P. of Mr. Young, Loanhead.	27 lbs. gunpowder were exploded in a cupboard. Probably powder grains on the stone floor outside were ignited by iron shod boots.	1	1
17 Jan. 1893	6—1893	R. P. of Mr. Lyttle, Maghera, Londonderry.	Accumulation of spilt powder ignited by friction or a match.	—	2
10 March 1893	18—1893	R. P. of Messrs. Sanders & Co., Kidderminster.	Shot got under base of a cartridge in an Erskine filling machine, firing the cartridge.	—	1
25 Sept. 1893	82—1893	R. P. of Messrs. Wood & Co., Gloucester.	Do. do. -	—	1
17 Nov. 1893	98—1893	R. P. of Mr. Gatland, Islington.	Ignition of fireworks in a room. Cause doubtful.	—	—
19 Sept. 1894	65—1894	R. P. of Messrs. Holland, 98, New Bond Street, London.	Tray of Elephant cartridges fell, and several exploded on account of their being placed nose to base.	—	1

No. CXIII.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING THE EXPLOSION

WHICH OCCURRED AT THE

AMMUNITION FACTORY OF MESSRS. ELEY BROTHERS, LTD.,

AT

ANGEL ROAD, EDMONTON,

On the 24th July 1895;

BY

CAPTAIN J. H. THOMSON, R.A.,

H.M. INSPECTOR OF EXPLOSIVES.

Presented to Parliament by Command of Her Majesty.

LONDON:
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1895.

[C.—7859.] *Price* 3½*d.*

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

Circumstances attending the Explosion which occurred at the Ammunition Factory of Messrs. Eley Brothers, Limited, at Angel Road, Edmonton, on the 24th July 1895;

BY

CAPTAIN J. H. THOMSON, R.A.,

H.M. INSPECTOR OF EXPLOSIVES.

SIR, Home Office, September 30th, 1895.

I HAVE the honour to report that, in obedience to your Order ($\frac{50651^{D}}{17}$) made under the 66th section of the Explosives Act, 1875, I have held an inquiry into the circumstances attending an explosion (No. 76/1895) which occurred on July 24th, in one of the buildings of the ammunition factory of Messrs. Eley Brothers, Limited, at Edmonton, by which five persons, whose names are given below, lost their lives. I also attended the adjourned inquest on the deceased, which was held by Mr. A. Hodgkinson, coroner for the Tottenham Division of the county of Middlesex, on September 23rd.

The factory at which the accident occurred, is situated near Angel Road Station, on the Great Eastern Railway. It was established in 1890, under a license (No. 89), dated 26th August 1890. The license authorises the manufacture of cartridges for small arms and percussion caps, and, as is well known, the trade of Messrs. Eley Brothers in these explosives is very large indeed.

The building (No. 15) in which the accident occurred, was one of a large group of buildings authorised for five alternative operations, with a proviso to the effect that not more than one of these operations is to be carried on in any one building at the same time.

Practically, however, this particular building was utilised for only one of the operations, viz., that of filling small-arm cartridges. The portion of the schedule to the Amending License (No. 673, 16th April 1895), now in force in regard to this group of buildings authorising this operation together with that of wadding cartridges, runs as follows :—

Distinguishing Number, Letter, or Name of Building, Room, or Place on Plan attached to License.	Application of Building, Room, or Place, or Process to be carried on therein.	Explosive allowed or Ingredients or Articles liable to Spontaneous Ignition or Inflammable, or otherwise Dangerous, and Limitation of Quantity to be in each Building Room, or Place.	Limitation of Number of Workpeople to be in each Building, Room, or Place.
1 to 18. 19 to 24, 1*a*, 1*b*, 2*a*, 25*a*.	*Each.* (*c*.) Filling and wadding cartridges for small arms, but not cartridges containing their own means of ignition at the same time as those not so containing.	*In each.* (*c*.) Gunpowder or any small-arm nitro-compound authorised for the time being, whether in or out of cartridges (other than safety cartridges), including any which may be contained in hoppers or other vessels outside the building, and connected therewith, 50 lbs. Safety cartridges, what is necessary for the supply and work of the building. Capped empty cartridge cases, what is necessary for the supply and work of the building.	*In each.* (*c*.) 4.

e 88930. Wt. 12732.

Description of building.

On the opposite page will be found a plan of the building in which the accident occurred, from which it will be seen that the centre or working part of the shed measured 13 ft. 6 in. × 10 ft., and that two external lofts or annexes were provided for the powder hoppers.

The building was constructed of wood, with a felt roof, and had three doors, viz., one small one at the top of each flight of steps leading to the external powder lofts, and a large double door communicating with the working compartment (or main building), and opening outwards on to the covered platform which leads to the other danger buildings. This platform is kept "clean," *i.e.*, free from grit, &c., and no person is permitted to make use of it without wearing the proper overshoes.

There was a large window at the back of the working compartment, and two smaller ones on either side of the door. The working benches ran along the two sides of the central compartment, as shown in the plan. The hoppers were large gun-metal castings resembling mortars, designed with a view to screening the building from the effects of an explosion of their contents, by directing such effects upwards. India-rubber tubes ran from the bases of the hoppers into the interior of the working compartment over the centre of each bench, to the ends of which when in use were fitted the filling-machines, or "hopper-tools" as they are termed at this factory.

Hopper-tool.

These machines are constructed of brass and gun-metal, and consist of a circular frame carrying a tube or cylinder, which constitutes the measure of the charge. The frame is fitted between two plates, and is capable of being revolved backwards and forwards through an angle by means of a small hand lever. At one end of the movement the measure is filled from the hopper, and at the other it discharges its contents through a spout into the cartridge case. In use the machine is held in one hand and the spout inserted successively into the necks of the cartridge cases, arranged for the purpose in trays, while with the other hand the lever is worked backwards and forwards. The hoppers are, as a rule, only used where there is a large order for cartridges filled with an ordinary charge of black powder. In the case of special orders and of cartridges to be filled with nitro-compound, a machine termed a "hand-tool" is employed. This is on the same principal as the "hopper-tool," but carries its own receptacle for powder, instead of being connected with the india-rubber tube.

The powder is brought into the building in closed zinc bottles, holding from 1 to 2 lbs., from the small separate shelter cupboard with which each of the filling rooms is provided.

Management.

The portion of the factory which included No. 15 building was under the charge of Mr. Collet (junior), who acted as foreman, the management of the whole factory being in the hands of Mr. Irvine (junior), who is also responsible for the working of the two other factories belonging to the Company.

Mr. Collet had been in the employment of the firm for about three years, and was looked upon as thoroughly reliable and trustworthy. As will be seen below, however, he was not very popular amongst the workpeople; but this unpopularity, as far as I could learn, was mainly due to a certain roughness of manner in dealing with his subordinates. I shall have occasion to revert to this matter further on.

Description of accident.

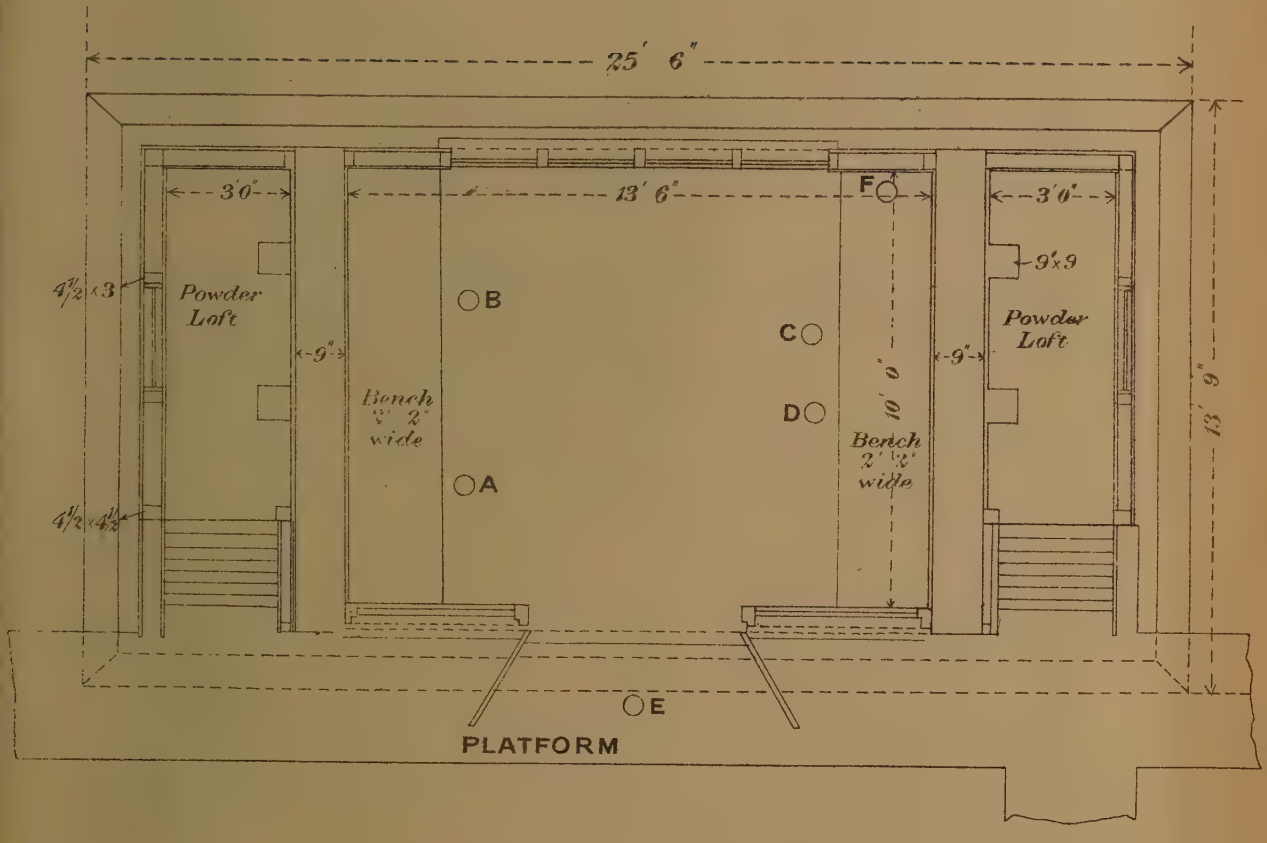
On the morning of the accident, work was proceeding at the factory as usual. Between 10 and 11 o'clock, Mr. Collet went to the building (No. 8) appropriated for filling cartridges with nitro-compound, and asked if there was a hand-tool to spare. He was told that there was not. He then asked what orders there were for E.C. cartridges, and, on being informed, he poured about 1 lb. of E.C. powder from one of the bottles in the shed into a smaller bottle, and took this, together with about 500 empty cartridge cases, away with him. He then went to the next shed (No. 7), and told Mary Whitbread, who was working there, to come with him to the charging shed (No. 15), Mrs. Whitbread expressed unwillingness, but finally obeyed. Mr. Collet then went to No. 14. and picked up a hopper-tool which was lying on the bench. He asked one of the workpersons, Susan Nott, whether it would do for smokeless powder. She replied that she thought not. He put it down, but afterwards sent Nellie Brooks, who was employed in No. 15, to fetch it.

Four persons were present in the latter building at the time of the accident, and a fifth was unfortunately passing the door, which was wide open. All these have succumbed to the injuries they received. Their names were as follows:—

GROUND PLAN. SHED Nº 15.

ANGEL ROAD FACTORY.

Eley Bros Ltd



Scale ¼" to the foot.

A *Probable position of Ellen Brookes.*
B „ „ *of Annie Nightingale.*
C „ „ *of Frederick Collet.*
D „ „ *of Mary Whitbread.*
E „ „ *of Lily Wiggett.*
F *Position of reel of Ballistite.*

Wyman & Sons, Ltd., Lith. 7615 - 10. 95

Name.	Occupation.	Date of entering Factory.	Nature of Injuries.	Remarks.
Frederick Collet - -	Foreman -	June, 1892 - -	Burnt on face, hands, arms and legs.	In the building.
Annie Nightingale -	Charger -	May 9th, 1891	Burnt on back, face, hands, arms and legs.	
Marian Whitbread -	„ -	April 1st, 1891 -	Burnt on head, arms, shoulders, left leg, and back.	
Ellen Brooks - -	„ -	May 9th, 1891 -	Burnt on head, back, face, arms and legs. Arm and thumb broken.	
Lily Wigget - -	Carrier to No. 13 shed	October 1st, 1892	Burnt on face, back of neck, hands, feet and arms.	Passing door.

The building in which the accident happened was visited by three persons immediately before the explosion occurred. From their evidence the probable position of the deceased persons, and the nature of the operations in which they were engaged, can be ascertained. These positions are shown in the plan of the building above. There is no doubt whatever that Mr. Collet had poured the small bottle of E.C. powder into the hopper in the right-hand annexe of the shed, and that at the moment of the explosion he was engaged in showing Mrs. Whitbread how to adjust and use the hopper-tool with this powder. That he had not filled more than one or two cartridges is also certain.

Mrs. Nightingale and Ellen Brookes were engaged at the other bench, the former in filling Martini-Henry rolled cases, and the latter in filling small (·410) sporting cartridges, both using hand-tools, with ordinary gunpowder.

Lily Wigget was passing, the door carrying about three trays of filled pistol central fire cartridges, and had certainly not entered the shed.

At the far end of the bench at which Collet and Whitbread were engaged there was a reel containing 23 lbs. of ballistite in the form of cords (like cordite), covered over, and on this bench there was probably no other explosive, except perhaps one or two cartridges filled with E.C. On the opposite bench there were a few bottles of gunpowder, but I have found it impossible to arrive at the exact number. In the hopper on this side, there may have been a few pounds of powder, but in the other one there was only 1 lb. These hoppers contain when full 8 lbs. of black powder. Altogether, I am convinced, both from the evidence obtainable, and from the small effect on the building, that the assigned limit of 50 lbs. was not exceeded. There were no trays of filled cartridges present, as the service waiters had just removed all that were ready.

The explosion occurred at about 11.5 a.m.

The report was by no means loud, being described by those who were 200 yards or so from the shed as resembling distant thunder. One person who was close by states that there were a number of small explosions preceded by a fizzing sound. This is extremely probable, as, after the first ignition, the bottles of powder would explode one by one. Others testify to the fact that there was no preliminary report, but that the first indication was given by a fizzing noise.

The shed appears to have been but little damaged by the explosion, but was afterwards completely destroyed by fire, so that there was little to be learnt from an inspection of the débris.

On hearing the explosion, several persons ran up to render assistance. The shed was then on fire. Of the deceased persons, Mrs. Nightingale and Mrs. Whitbread were still in the building lying on the floor, and were speedily rescued from the flames. Ellen Brookes had run or crawled out, and was lying in a ditch close by. Lily Wigget was running across the field, with her clothes on fire. Mr. Collet had succeeded in escaping from the building, but I obtained no evidence as to where he was when the rescuers reached the spot.

The injured persons were attended to, and removed to the hospital as speedily as possible.

Cause. With regard to the cause of the accident, I may say at once that, in view of the scanty and somewhat contradictory statements made by some of the deceased persons, it is impossible to determine the cause with any certainty. It is to be regretted that, owing to their precarious condition, I was unable to personally interrogate any of the deceased.

The accident is, I believe, without precedent since the passing of the Explosives Act. There have, it is true, been two accidents in filling cartridges on the registered premises of gunmakers, but in such cases many conditions existed which are wholly absent in a factory for explosive. Neither in the Royal Laboratory at Woolwich, nor at any private factory, has there been any accident in a building appropriated to the filling of small-arm cartridges during the period named, notwithstanding the fact that some hundreds of millions of cartridges have been filled in the manner in which the operation was being carried out in the present instance.

Before proceeding to discuss the relative probability of the various causes which might produce an accident of this description, I think it advisable to set down as nearly as possible in their own words, the various statements made by the deceased, bearing on the subject.

These are as follows :—

tements deceased.

Frederick Collet, when visited by Mr. Irvine (senior) at the hospital on the afternoon of the accident, stated :—"I have not the least idea how it happened. I was "adjusting the hopper-tool to the proper charge. I heard something, and turned "round, and saw the place in flames. I did not hear anything drop."

On a subsequent occasion he stated to his father :—"The first explosion occurred "outside. A girl dropped her work."

On both occasions Mr. Collet was conscious and clear in his mind.

Mrs. Nightingale stated to John Parks, who assisted in rescuing her from the burning building :—"A girl dropped her tray of cartridges, and that caused the "explosion."

She made no statement to her husband as to the cause, although he was with her up to her death, and she was conscious for part of the time.

Mrs. Whitbread stated to her husband soon after the accident :—"Mr. Collet asked "me to go down to the charging shop, and I did not want to go. He said 'It's "'nonsense, you will have to go.' He wanted me to use an old tool. I said, 'The "'tool is not fit to use.' He said, "It's nonsense.' He was in the act of using the "tool, and dropped his work and caused the explosion. I believe the carrier dropped "her work afterwards, which caused a second explosion. It was entirely Mr. Collet's "fault."

When visited at the hospital by William Goff, on the evening of the same day, she stated "Mr. Collet placed some E.C. powder in the hopper, and he charged a "cartridge, and it went off."

Ellen Brookes, when visited at the hospital by Susan Nott, stated :—"I heard a "fizzing noise, and turned round, and knocked over my stool. I crawled towards the "door, and Mr. Collet fell over me."

As far as I could learn, Lily Wigget made no statement at all.

Assuming, in the first instance, that there was no intention to mislead, on the part of either of the four persons, the statements may be summarised as follows :—

Name.	Place where Explosion originated.	Cause.
Collet	Behind him	Not known.
„	Outside door	Fall of tray of cartridges.
Nightingale	Not stated	Fall of tray of cartridges.
Whitbread	At hopper-tool	Charging a cartridge.
„	Near Collet	Fall of Collet's work.
Brookes	Behind her	Not known.

The above statements are in the highest degree conflicting. This may be accounted for partly by the fact that the victims of an accident by explosion are frequently quite unable to give clear evidence as to the cause, or even to state whereabouts it originated. There is often a tendency to mix up cause and effect where the whole occurence occupies so short an interval of time.

Bearing these points in mind, it may be well to see whether the statements cannot be brought more nearly into agreement. It will be observed that Collet and Nightingale agree in ascribing the accident to the fall of a tray of cartridges, which must have occurred outside, as there were no full trays in the building, and as there was no reason for partially-filled ones to be lifted at all. But it must be remembered that Nightingale made this statement immediately after the accident, and that Collet at first was unable to ascribe a cause. It is possible, therefore, that the latter had heard of Nightingale's statement, and, thinking the matter over, came to the

conclusion that this was the most probable cause. That Whitbread had heard of Nightingale's statement appears very probable from her remark as to the fall of the tray causing a second explosion.

For the purpose of reconciling the various statements of the four persons on the supposition that they were all perfectly *bonâ fide*, I will assume the following to have been the order of events, the whole interval of time being, of course, extremely short.

1. The first ignition was not attended by any report, but began with a fizzing noise. This is supported by the statement of Brookes and of those outside who were nearest to the shed.
2. The first person to observe it was Brookes, who turned sharply round, upsetting her stool.

   (In the present instance, I attach little importance to the fact that Brookes was the only one who sustained injury other than burns, though in many cases this might be taken as an indication that she was nearest to the seat of the explosion.)
3. The rapid movement of Brookes attracted the attention of Nightingale and Collet, while at the same moment, Wigget who was passing the door, saw the flame and dropped the trays she was carrying.
4. Nightingale associated the cause with the event which occurred at the moment when she first noticed the conflagration, and possibly Collet did the same.
5. Whitbread was the last to observe the fire, and did so at the moment when Collet dropped his work in order to escape. She therefore also associated the cause with the event which was simultaneous with her first observation of the disaster, and did this the more readily because, not only was she ill-disposed towards Collet, but she was also very adverse to the use of this particular hopper-tool.

I will now enumerate the possible causes of an accident of this description, and discuss in detail their relative probability. Possible causes.

These are as follows:—

Outside causes	(1.) Lightning. (2.) Concentration of sun's rays. (3.) Spark.
Illegality, carelessness, &c.	(4.) Malice. (5.) Skylarking. (6.) Matches. (7.) Use of iron or steel implement. (8.) Non-wearing of overshoes. (9.) Smoking.
Causes connected with filling tools	(10.) Grit in hopper. (11.) Friction and undue force. (12.) Foreign substance in powder.
Causes connected with percussion caps and capped cartridge cases	(13.) Over sensitive percussion cap. (14.) Loose percussion cap on floor. (15.) Fall of a cartridge or cartridge case. (16.) Blow on a percussion cap with a hard substance. (17.) Pinfire case.
Miscellaneous	(18.) Spontaneous ignition of nitro-compound.

(1.) This cause may be at once dismissed as there was no sign of a thunderstorm at the time. Lightning.

(2.) The concentration of the sun's rays has been the cause of several fires in private houses, and of more than one explosion; but such concentration can only occur where some article is present which can serve as a lens. Thus, a "bull's-eye," pane of glass, or a bottle of water, have been known to produce the result. In the present instance, as far as could be ascertained, no such article was present, and there were no "bull's-eye" panes in the windows. Sun's rays.

(3.) The probability of the accident having been caused by a spark is also very remote. There are no factory chimneys on the side to which the door opened, and the railway which the shed faced is distant over 200 yards at the nearest point. The wind at the time was moderate and from the south-west, in which direction the distance to the railway would be considerably greater. Spark.

Malice.

(4.) I have been obliged to include malice among the possible causes, as more than one disastrous explosion has been traced beyond doubt to the diabolical action of individuals. In the present instance there is not the smallest evidence in favour of such a cause, except the mere fact that Mr. Collet was unpopular; and even this has little or no significance because it could not have been foreseen that he would be working in that particular building, and there would have been no opportunity for any person to take the steps necessary to produce an explosion after he had entered the shed. I think, therefore, that this cause may be dismissed as most improbable.

Skylarking.

(5.) Undoubtedly an accident might be caused by what I have termed "skylarking" amongst the workpeople; but the presence of Mr. Collet renders it improbable that any such irregularity could have occurred. He was not the sort of man to allow, much less to take part in, anything of the sort.

Match.

(6.) With regard to the possible introduction of matches, I regret to say that the result of my inquiry showed that the searching of the workgirls had not been efficiently carried out. The forewoman who was responsible for the searching of those employed in this portion of the factory admitted that she frequently neglected this most important duty. In the absence of any efficient system of searching, I cannot but regard this cause as, at any rate, a very possible one.

The special rules provide that no pocket shall be worn in a danger building; but as the duty of enforcing this had been neglected, it is quite probable that the rule had become a dead letter.

It must not be supposed that the carrying of matches is confined to persons addicted to smoking. The habit of putting them loose into the pocket is, I believe, very common to both sexes of the working classes, and it is especially on the women that the duty of lighting fires, &c., falls. Moreover, in the case of females, the pocket into which the match is put, would probably be the same as that which contains the handkerchief, and in withdrawing the latter the match would be very likely to fall on the floor unperceived. The movement of a foot or of the leg of a stool would be sufficient to ignite it, and such ignition might even take place without the report usually accompanying the treading on a lucifer.

Iron or steel implement.

(7.) The use of an iron or steel implement is also a very possible cause. It is not likely that one of the workgirls would have made use of such a thing in the presence of the foreman, nor, indeed, would there be any reason for their doing so; though it is quite possible that, as they had not been searched, one or other of them may have had scissors or some such implement in her pocket. But we know that Mr. Collet himself was engaged in adjusting the hopper-tool, and for this purpose he may have made use of a pocket knife or other steel implement. If he did so, we must suppose that his statement was not made *bonâ fide*, but was intended to shield himself.

There are, however, apart from Mr. Collet's statement, two facts which made it improbable that this was the true cause. In the first place, if Mr. Collet had committed this breach of the rules, Mrs. Whitbread, who was unfavourably disposed to him, and who was brought to the shed against her will, would most probably have mentioned the fact; and, secondly, no steel implement was found in the ruins of the building.

Non-wearing of overshoes.

(8.) The non-wearing of overshoes is in this instance a very improbable cause. Owing to the excellent system of covered "clean" platforms, which connect all the buildings in this part of the factory, the usual temptation to the neglect of this precaution is absent, while any person walking about without the overshoes would be easily detected.

Smoking.

(9.) It is inconceivable that Mr. Collet, the only man present, should have been smoking at the time of the accident. Had he been doing so, abundant evidence of the fact would have been forthcoming.

Causes connected with filling-machines.

(10.) to (12.) We now come to the causes connected with the filling tools, and, before considering these separately, it will be necessary to say a few words about the particular operation which was being carried out by Mr. Collet. This was, in fact, a most unusual one, inasmuch as nitro-compound cartridges were never filled with a "hopper-tool," and, moreover, the shed was usually appropriated for filling with black powder. The operation was in the nature of an experiment, and was a perfectly legal one, and, in my opinion, unattended with any special danger. It is, however, only natural that, as an unusual operation was in progress, suspicion should at once have fallen on this as the cause of the accident. Evidence was given at the inquest by Susan Nott which tended to show that the "hopper-tool" was quite unsuitable,

and even dangerous, to use with a nitro-compound, and to some extent, this was supported by Mrs. Whitbread. But on going fully into the evidence of the former, I found it to be based principally on the fact that it had been found difficult to measure uniform charges of a nitro-compound with a "hopper-tool," and also that this particular "hopper-tool" had not been used for some time. There is not the slightest reason to suppose that Whitbread knew anything more about the tool: but there is good reason to think that, having been prejudiced against it from the knowledge that it had not before been used for a nitro-compound, she was over-ready to attribute the accident to a cause connected with such use. Against the probability of the explosion having originated with the tool, there is the statement of Collet himself, and it is hardly conceivable that if the first ignition had occurred in his own hands, he should have imagined that it originated behind him, nor if he had been the first to observe the ignition, is it very likely that Brookes could have fallen across his path in the doorway.

Moreover, many millions of rounds of black powder have been filled from hopper-tools identical with, or similar to, the one employed, without mishap; and I see no reason whatever for supposing that any greater danger exists when nitro-compound is employed, nor that the hopper-tool is for this purpose in any degree more dangerous than the hand-tool ordinarily employed for such compounds.

Of the three possible causes connected with the "hopper-tool," (10) is perhaps the most probable. The hopper had not been in use for some time, and had remained uncovered. With regard to this, I may say that on the occasion of my last inspection of the factory, to the best of my recollection, the hoppers of this building and of the adjoining ones had covers on them; and I am informed that covers did exist at that time; but I found those of another group of buildings uncovered, and gave instructions that covers should be provided. I need hardly say that this was intended to apply to all hoppers in the factory which were uncovered; but I am informed that my instruction was understood to refer only to the particular group of buildings where the defect was pointed out. I am bound to say that I regard this interpretation as exhibiting a certain want of intelligence on the part of those to whom the instruction was given. Grit.

The object of covering the hoppers is twofold; viz., to prevent grit or foreign substances getting in, both when the vessel is in use or when it is standing empty, and also to prevent the communication of explosion by a burning fragment projected into the hopper compartment through the window or otherwise.

As the hopper had remained for some time uncovered, it is reasonable to suppose that a certain amount of dust and grit may have fallen into it, and this getting into the hopper-tool might have caused the accident. But, in view of the general remarks above on the causes (10) to (12), I regard the probability as somewhat remote.

(11.) I have said that the hopper-tool had not been in use for some time, for how long exactly I was unable to discover. It is possible that it had come to work somewhat stiffly from disuse, but I was unable to obtain evidence that such was the case. I think it highly improbable that, if the machine had been so far out of order as to need the application of considerable force in working it, Mr. Collet would have attempted to make use of it at all. The tool had certainly not been put on one side as unfit for use, and it was in point of fact taken from the bench in No. 14, where it would have been taken into use at any moment if required. Friction.

The remains of the tool have been recovered, but they are so much damaged by fire that nothing can be learnt from them.

The remains of several of the hand-tools have also been found, but it is most unlikely that the accident was due to one of these.

(12.) The most dangerous foreign substances which may find its way into the powder is a fragment of cap composition in the case of powder which has been recovered from broken-up cartridges. I was able to ascertain, however, beyond doubt in the present instance that the E.C. powder which Mr. Collet used had not been previously loaded into cartridges; and I am also satisfied that, with the system in force at the factory, the chance of other foreign material finding its way into the powder is very small. At the same time I learnt with regret that the Company do to a small extent make use of powder recovered from broken-up cartridges after it has been examined. I do not think that any examination would be sufficient to detect a small particle of cap composition, and I therefore consider it highly desirable that all such powder should be invariably promptly destroyed. Foreign substance.

There remains the possibility that the black powder which was being used by Brookes and Nightingale had been recovered from broken-up cartridges, but, from the whole of

the evidence, it is exceedingly improbable that the explosion originated in the hand-tools which they were using.

Over-sensitive percussion cap.

(13.) I have set down separately, as a possible cause, an over-sensitive percussion cap, though, in point of fact, this is presupposed in the causes (14) to (17), which follow. My reason for referring to it separately is that, while this report was in progress, two other accidents occurred at the same factory, which may tend to throw some light on the one under consideration. In the first (No. 85, 1895), a central fire cartridge exploded while it was being gauged, and at a moment when, according to the evidence of the girl, who was slightly injured by the accident, no force whatever was being used upon it. It is possible that she did actually press the cartridge into the gauge with the edge of the base of another one, but, even so, the cap must have been in a dangerously sensitive condition to cause an explosion.

Explosion of pinfire cartridge.

In the second accident (No. 90, 1895) a pinfire cartridge exploded whilst being wadded.

Messrs. Eley's caps are under ordinary circumstances by no means very sensitive, and require a rather heavy blow to fire them. This firm is, however, the only one in the kingdom which makes use of the "wet" process of mixing composition and filling percussion caps; that is to say, that, until the composition has been inserted into the cap, and pressed, it contains sufficient water to be absolutely uninflammable. This is undoubtedly an efficient method of obviating the dangers attending the mixing of these compositions, but it has one serious defect, which contributed to its abandonment after trial at Woolwich Arsenal. This defect is a tendency at times to produce a highly sensitive cap, a tendency which is probably due, eitherto the liability of all chlorate mixtures on drying to form minute crystals on the surface, or else to the occasional formation of what may be termed a smear of composition on the walls of the cap. It is true that the plungers of the press are made so as to be a tight fit in the caps, but it is obvious that slight variations may occur in the sizes of the latter, and that it would be impossible to entirely guard against the formation of a smear, while probably the sensitiveness of this layer of composition between the side of the anvil and the wall of the cap would increase as its thickness diminishes.

Whether the extra sensitiveness is due to the wet process or not, the fact remains that, as stated above, a cartridge did explode when little or no force was being applied to it; and therefore it is possible that the present accident may have been caused by the mere handling of a cartridge or cartridge case containing an equally and abnormally sensitive percussion cap.

Loose percussion cap.

(14.) The presence of a percussion cap on the floor is not very probable. No doubt it is possible for a cap to be so loose in the cartridge case as to drop out; but it is hardly probable that the cap would have remained in the case during the packing and transport of the latter, only to drop out when it reached the filling-room.

Added to this, there is the further improbability of such a cap causing an explosion, though it might do so if the anvil remained in it and if at the same time it happened to be more than usually sensitive.

This cause depends on the concurrence of two rather improbable events, and may, therefore, be set aside in view of the other causes presenting a higher degree of probability.

Fall of cartridge.

(15.) It will be necessary to deal with the probability of the accident having been caused by the fall of a cartridge, or tray of cartridges, at some length; not only because the statements of the deceased seemed to point to this as the true cause, but also because there are two features in the Eley cartridge which render the explosion of a cartridge by a fall quite possible. With regard to the statements of the deceased persons, I do not wish to imply that they are without foundation, but I have endeavoured to show in the theory propounded on page 7 that they are not altogether inconsistent with some other cause of ignition. It is true that reference to a fall is made by three out of the four injured persons who made statements before their death, but I think it highly probable that Whitbread, and, possibly, also Collet, had heard Nightingale's statement that this was the cause of the accident. I also think it possible that the latter associated the event which she observed at the moment of the first alarm with the cause of the accident. From their positions, Collet and Nightingale would most readily have seen Wigget drop her trays of cartridges; and that she did drop them is certain; but there are reasons for supposing that her action was the effect, and not the cause, of the accident.

The first of these reasons is that it is difficult to see how the fall of the cartridges on the platform outside, containing, as they did, only a small quantity of gunpowder,

even if they did explode, could ignite the contents of the building. Of course it is possible that Wigget made a stumble, and projected the contents of the trays up to the door of, or even into, the building.

The second and more important reason is that there is no evidence whatever of any noise or clatter preceding the first ignition. Rose Holywell, the carrier for No. 15, when she came out of that building, saw Wigget at the end of the platform. The latter called to Holywell to wait for her, and she did so for a short time, and then walked slowly round the corner of No. 15. She had proceeded only a few yards when the explosion occurred. Holywell, who was delaying in order that Wigget should catch her up, must have had her attention fixed on the direction from which the latter was coming, and yet she, of all the witnesses I examined, was most emphatic that the explosion commenced with a fizzing sound.

I am well aware that the above reasons are far from being sufficiently cogent to entirely negative the possibility of the accident having been caused by the fall of Wigget's work; but, in my opinion, they do considerably lessen the probability of such having been the case.

The fall of a cartridge may have occurred inside the building, but it is difficult to see from whose hands it can have fallen. Whitbread, as far as we know, was not working, but was watching Collet, and, therefore, unless she knocked a cartridge off the bench with her sleeve or otherwise, she could not have been responsible for the fall. There is every reason to believe that Brookes and Nightingale were charging cartridges at the moment, and not carrying them about, though one or other of them might have been "trying," *i.e.*, weighing one of her charges. But if either of these two dropped a cartridge it is difficult to believe that she was ignorant of the fact, or that she should have wilfully concealed it.

The same argument applies to Collet, who, from the nature of the work he was doing, would have been the most likely to have caused the fall of a cartridge. It is true that Whitbread, in one of her statements, did affirm that Collet caused the accident in this way, but her statements are so confused and so evidently tinged with prejudice, that I do not attach much importance to this; and I have already endeavoured to show how she might have been misled.

That it is possible for a cartridge to be exploded by a fall, there can be no doubt, though such an occurrence is very rare. I have already said that there are two causes which would tend to make the cartridges at this factory somewhat more liable in this respect. The first of these is the tendency to occasionally produce a highly sensitive cap by the employment of the "wet process" of filling. To this I have referred above (p. 10). The second cause is one which is common to all sporting cartridges, viz.: the use of an unshouldered anvil. Some years ago a good many cases* occurred in the Royal Laboratory of filled cartridges for the Snider rifle, and even of cartridge cases exploding from a fall. In consequence of this, a shouldered anvil was introduced into service cartridges, and since then, so far as I am aware, there is no record of a similar accident. In sporting cartridges, however, difficulties in connexion with the variations in guns of different manufacture have prevented the introduction of the shoulder, and consequently the point of the anvil always bears on the composition of the cap. On the other hand, Eley's cap composition is in general by no means a sensitive one, and it has been rendered less so in recent years by reducing the proportion of fulminate of mercury and by omitting ground glass as an ingredient. The caps are, moreover, all coated with tin foil.

To test whether, under normal conditions, these caps are specially liable to be exploded by a fall, I requested the Company to try the experiment of dropping 100 filled central-fire cartridges taken from the run of work, one by one, from a height of 10 to 15 feet, on to a hard surface. This was done, and not one out of the hundred exploded. Evidently, therefore, the liability, if it exists, must be very exceptional; indeed, if it were otherwise, the cartridges made by the firm would never have attained the deservedly high reputation in which they are held by sportsmen.

(16.) A blow on the percussion cap of a cartridge with a hard substance is, of course, a possible cause; but it is not easy to see how a sufficient blow could have been given, except by the cartridge falling base downwards on to some angle or point of a hard substance, in which case, this cause should be included with No. 15 above, being merely one of the means by which a cartridge may be exploded by a fall. Blow on cap.

If the cap happened to be an over sensitive one, it is possible that a very light blow or pressure might explode it; but the cause would then be the sensitiveness of the cap (No. 13) rather than the blow which it received.

* Official Treatise on Military Breech-loading Rifles, 1869, Appendix B.

I think that the probability of a normal cap having received a sufficiently heavy blow, otherwise than by a fall, to cause this explosion is so remote that it needs no further consideration.

Pinfire case.

(17.) Among the débris after the accident, there was found the remains of a pin-fire case, about which there is some slight mystery. It is true that pin-fire cartridges had been loaded in the shed on the morning of the accident, but these have all been accounted for, and the whole batch had been removed from the building. Moreover, it is evident that the cartridge in question is not one of these, as it has a long pin of a kind only used for poacher alarms. Cartridges of this description had been filled in the building more than a month before, but it is not known how this particular case came to be overlooked when the work was removed. It is probable that it was rejected for some defect, and that it had lain in a position where it could not be observed. Pin-fire cartridges are always considerably more dangerous than central-fire, and this is one of the reasons that they are now so little used.

Their safety, indeed, depends largely on the degree of tightness with which the pin is set into the case. It is quite possible that this case was rejected on account of a loose pin. Or, again, the cartridge case may have been jammed in a position where it was subjected to some slight movement which, aided by the leverage of the long pin, would tend to loosen the latter. The point of the pin would then bear on the cap composition, and any further movement accompanied by pressure would inevitably fire the cap. The explosion of the latter, if caused in this way, might well be unattended by any sharp report.

Taking all things into consideration, I cannot but regard this as the most probable cause of the accident.*

(18.) There remains also the possibility of the explosion having been caused by the spontaneous ignition of a nitro-compound. This cause may, I think, be dismissed in a few words. The qualities of E.C. powder are so well known now that the probability of its having spontaneously ignited at this particular moment is almost *nil*. The only other nitro-compound present was ballistite, and this if properly made is also a very stable explosive. Moreover, it is scarcely possible that an explosive of this description merely covered with a cloth, and therefore practically exposed to the air, should develop sufficient heat by decomposition to ignite; and certainly it could not do so without first giving off fumes which must inevitably have drawn attention to its condition.

Most probable causes.

I will now tabulate the causes which, in my opinion, present any considerable degree of probability, commencing with the one which I consider to be the most probable, and which appears to me to be most in accord with the evidence which I was able to obtain—

(1.) Pinfire case (17).
(2.) Fall of cartridge trays outside the door (15).
(3.) Over sensitive percussion cap (13).
(4.) Match (6).

It is certain that wherever the first ignition may have occurred, the flash was very rapidly transmitted to the reel of ballistite in the corner of the building. The injury to the deceased persons was, without doubt, mainly due to the intense flame given out by this explosive.

I feel it my duty to state that, although the firm were within their legal rights in having this reel of explosive in the building, it was very unwise not to remove it to the magazine when no longer required. This may be termed an error of judgment. I have already alluded to the neglect of duty in regard to the searching of women employed, and also to the disregard of my instructions in respect to covering the hoppers; but, as these two omissions are, in my opinion, scarcely likely to have led to the explosion, I do not think that any blame can be properly or definitely assigned to the Company or to their employés in respect of the accident.

Inflammable clothing.

There is one other point to which I think it necessary to call attention, viz.; the inflammability of the clothing of the work persons. Without doubt, the injuries to the deceased Lily Wigget were mainly due to her clothing having caught fire, and it is probable that the lives of one or more of the others might have been saved if their working dress had been of a more decidedly uninflammable material. The licence for the factory requires that woollen or other uninflammable dresses shall be

* I have already (on page 10) alluded to an accident at the same factory caused by a pin-fire case which occurred whilst this Report was being prepared.

worn, and the dresses provided by the Company are in strict conformity with this requirement, being composed entirely of wool. The material, however, consists of a tartan serge of somewhat open texture, which is by no means strictly uninflammable. It would no doubt be difficult to find any dress material which would resist the intense heat of the sustained flame from an explosive like ballistite ; but it is perfectly easy by treatment with certain salts to render cloth so far uninflammable that it ceases to give off flame immediately the source of heat is removed. I am in communication with Messrs. Eley Brothers in regard to the adoption of some such treatment in their factory.

Verdict of Coroner's jury.

The Coroner's jury returned a verdict to the effect that the deceased were killed through an explosion in the cartridge-charging shed, but the evidence was insufficient to show how such explosion was caused. They desired to suggest to Messrs. Eley Brothers that in future dry composition only should be used in the manufacture of caps.

I have the honour to be,
Sir,
Your obedient servant,

J. H. THOMSON, Capt. R.A.,
H.M. Inspector of Explosives.

The Right Honourable
The Secretary of State
Home Department.

No. CIX.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING AN EXPLOSION

WHICH OCCURRED IN A

MIXING HOUSE AT THE FACTORY OF THE NATIONAL EXPLOSIVES COMPANY, LIMITED, AT UPTON TOWANS, GWYTHIAN, NEAR HAYLE, CORNWALL,

On the 4th September 1894;

BY

COLONEL A. FORD,
HER MAJESTY'S INSPECTOR OF EXPLOSIVES.

Presented to both Houses of Parliament by Command of Her Majesty.

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REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON

The Circumstances attending an Explosion which occurred in a Mixing House at the Factory of the National Explosives Company, Limited, at Upton Towans, Gwythian, near Hayle, Cornwall, on the 4th September 1894;

BY

COLONEL A. FORD,
HER MAJESTY'S INSPECTOR OF EXPLOSIVES.

SIR, Home Office, 22nd October 1894.

I HAVE the honour to report that in obedience to your Order of the 10th September (H.O. Papers 54118 A.C./23), I have held an Inquiry into the circumstances attending an explosion which occurred in a mixing house at the factory of the National Explosives Company, Limited, at Upton Towans, Gwythian, near Hayle, on the 4th September, by which two men lost their lives.

Upton Towans factory.

The factory at Upton Towans was established in virtue of a license (No. 86), dated the 5th December 1889, by the Kennall Gunpowder Company, and on the 13th of the same month notice was sent to the Secretary of State, under sections 13 and 39 of the Explosives Act, by the National Explosives Company, Limited, that the factory had passed into their occupation. It has since been worked by that company. Three amending licenses, viz., No. 439, dated 19th December 1889; No. 452, dated 31st March 1890; and No. 525, dated 9th September 1891, by which the details of the original license have been modified, have since been granted for the factory. Mr. John Wimble Wilkinson is the manager, but the danger area, which is the only part included in the license, is entirely under the direction of Mr. William Bate, the chemist in charge. It is divided into two parts, termed respectively the "wet part," in which the nitro-glycerine is made, and the "dry part," in which the nitro-glycerine is converted into an explosive suitable for the general market. Each of these parts is under a foreman.

Mixing house.

The mixing house in which the explosion took place is marked N^1 on the plan of the factory. The walls were of wood, in two thicknesses, with a layer of "breeze" between them, and the roof was of wood, felted over externally. It had a close-joined wooden floor, and the interior (except the floor) was varnished. Outside the building at one end there was an annexe containing a small steam-engine for driving a mixing machine, and beyond the annexe a raised platform about the level of the eaves of the building, on which stood a large tub or cistern full of water, with an arrangement for heating it by the injection of steam. The steam for both the engine and the water in the cistern was obtained from a boiler-house outside the danger area and distant some 500 yards. The building contained, in addition to the mixing machine, five leaden troughs set in framework of wood. These were used for a preliminary mixing of the explosive by hand before it was treated in the mixing machine. The troughs, as well as the mixing machine, were surrounded by jackets through which a continuous flow of hot water from the cistern could be kept up, the water being carried off into a drain

by a $\frac{3}{8}$ths-inch pipe, while an inlet pipe with a buoy cock kept the cistern full. The dimensions and general arrangement of the building will be seen from the accompanying plan, No. 1, which has been furnished to me by Mr. Oscar Guttmann, one of the directors of the company, and their consulting engineer, under whose superintendence the works were originally erected.

The building was surrounded, except at one corner and in front of the doorway, where there was a lunette as shown on the plan, by a very substantial mound of sand, faced with turf, as high as the top of the roof. There was a small door at the unprotected corner with a tramway leading to it for supplying the ingredients to the building, while the manufactured explosive was removed by the main entrance behind the lunette by means of another tramway.

The leaden tanks, five in number, were rectangular, about 3 feet 9 inches long by 1 foot 9 inches wide, and 1 foot 5 inches deep, and require no special description. The mixing machine was of the kind known as "Werner and Pfleiderer," similar to those used for kneading dough for bread. The interior, which was of brass, was shaped thus in section : and contained two axles which revolved in opposite directions, one at half the speed of the other. The axles were each fitted with four arms or paddles, also of brass, set in a helix, and there was an arrangement for reversing the direction of the revolutions, in order to make the mixture of the ingredients more intimate.

Both the trough of the mixing machine and the tanks, as above stated, were heated by hot water, a raised temperature being necessary to enable the nitro-glycerine and nitro-cotton to enter readily into combination with one another without the aid of a solvent, the use of which would alter the character of the product. The maximum temperature of the water in the cistern outside the building was stated to be 70° cent. (158° Fah.), while that of the explosive in course of manufacture was 55° cent. (131° Fah.) in the tanks, and 50° cent. (122° Fah.) in the mixing machine.

The explosives authorised to be manufactured in the factory are dynamite No. 1, blasting gelatine Nos. 1 and 2, and gelatine dynamite Nos. 1 and 2. The operations allowed to be carried on in the two mixing houses, marked N[1] and N[2], were as follows :—

Distinguishing Number, Letter, or Name of Building, Room, or Place, on Plan attached to License.	Application of Building, Room, or Place, or Process to be carried on therein.	Explosive allowed or Ingredients or Articles liable to spontaneous Ignition or Inflammable, or otherwise Dangerous, and Limitation of Quantity to be in each Building, Room, or Place.	Limitation of Number of Workpeople to be in each Building, Room, or Place.
N[1] N[2]	*Each.* (*a*) Mixing nitro-glycerine and ingredients to form dynamite. Sifting nitro-cotton.	*In each.* (*a*) Nitro-glycerine and wholly or partly manufactured dynamite, in all 15 cwt.	*In each.* Five, exclusive of two overlookers and two service waiters.
	Or, in lieu,		
	(*b*) Mixing nitro-glycerine and ingredients to form blasting gelatine or gelatine dynamite.	(*b*) Nitro-glycerine, nitro-cotton, and wholly or partially manufactured blasting gelatine or gelatine dynamite, in all 15 cwt. Non-explosive ingredients; what is necessary for the immediate supply and work of the building.	
	Provided that the operations (*a*) and (*b*) shall not be carried on in the same building at the same time.		

At the time of the explosion, operation (*b*) was being carried on in both of the mixing houses, a variety of gelatine dynamite No. 2,* known as gelignite, being in course of manufacture.

* Gelatine dynamite No. 1 is defined as consisting of thoroughly purified nitro-glycerine, thickened by being combined with nitro-cellulose, carefully washed and purified, and mixed or incorporated with one or more of the following non-explosive ingredients, viz., cotton, charcoal, or such other ingredients as may for the time being be sanctioned by a Secretary of State, and in such proportions that the whole shall be of such character and consistency as not to be liable to liquefaction or exudation.

Gelatine dynamite No. 2 is defined as consisting of gelatine dynamite No. 1 as above defined, mixed or incorporated with nitrate of potash, or such other nitrate as may for the time being be sanctioned by a Secretary of State.

In making this explosive a charge, consisting of 130 lbs. of nitro-glycerine and nitro-cellulose, or nitro-cotton, as it is ordinarily called, in the proper proportions, was stirred for a period varying from two to four hours in one of the leaden tanks in the mixing house with a wooden spud. It was then transferred in small portions at a time on the spud to the machine, which was kept running, and there it remained until the workman judged by eye that the nitro-glycerine was entirely combined with the nitro-cotton. This occupied a few minutes only, or extended even to an hour. The "absorbing powder," consisting of the other ingredients (viz., nitrate of potassium and wood meal), was then added, and after a further period in the machine the process was completed.

The system of work in the mixing houses, in each of which two men were employed, was described to me as follows:—The building having been cleaned up on Saturday, the proportion of nitro-glycerine for five charges was brought and placed in the five tanks, which were then cold, or nearly so, so as to be ready for commencing work on Monday morning.*

Work begins daily at 7 a.m., and on arrival at that time on Monday the steam was first turned on into the cistern, and as soon as the temperature of the water reached 70° cent. (158° Fah.) it was allowed to circulate through the jackets of the mixing machine and the tanks. The heating of the machine and the tanks occupied about half an hour, and in the meantime a supply of five bags of nitro-cotton had arrived at the building. These were emptied on the nitro-glycerine in the tanks, and the stirring process commenced and continued until breakfast time at 9. After breakfast one of the charges was transferred from the tank to the machine, and when that was completed another followed. As the tanks were emptied each was re-filled with ingredients and stirred as before. In this way seven or eight charges were finished in succession during the day and removed to the cartridge huts. At the conclusion of work the charges were left in the tanks for the next day, when the routine was the same, except that, as the machine could be put to work earlier, there being charges ready in the tanks, the out-turn would be 10 or 11 charges. Similarly 10 or 11 charges could be dealt with on Wednesday, as also on Thursday and on Friday. On Saturday work was suspended at 2, five or a less number of charges being passed through. The building was subsequently cleaned and washed, and the supply of nitro-glycerine placed in the tanks for the succeeding week.

Circumstances of explosion.

On the morning of Tuesday the 4th of September, work commenced at 7 o'clock as usual, and Mr. Elisha Trewartha, the foreman of the dry side (*i.e.*, the portion of the factory in which the liquid nitro-glycerine is converted into an authorised explosive, as above stated), on going his round shortly afterwards visited N^1 mixing house at 7.15. Only one man, Samuel Pick Craze, aged 30, was then in the building, the leading hand, James Perry, aged 54, being temporarily absent, removing some packing cases. Craze was engaged in stirring a charge in one of the tanks with the spud. Trewartha noticed that the whole of the five tanks contained charges. The machine was empty and not yet running. He left after being in the building about five minutes, having observed that all was in order. He paid the building another visit about 8.35, but did not then go into it. Standing at the front door, he saw both Perry and Craze there, the former stirring at one of the tanks, and the latter looking into the trough of the machine, which was in motion. Soon after Trewartha had arrived Henry Cliff, a service waiter (*i.e.*, a man engaged in conveying explosive from one building to another), brought a trolley to the front of the building to take away six boxes of mixed gelignite (200 lbs.) which were ready for removal. These were handed out to him by Perry and Craze, and stowed by him in the trolley. Cliff did not enter the building. He then moved the trolley away. Trewartha had left the building while the boxes were being placed in the trolley.

About three minutes later (viz., at 8.38) Arthur Dingle, a man employed on the wet side of the factory, brought 240 lbs. of nitro-glycerine in eight buckets to the back of the building, and passed them in to Perry and Craze, who poured the contents of four of them into one of the tanks, handing back the buckets to Dingle, and placed the remaining four, closed with wooden covers, upon a plate of lead for that purpose on the floor of the room. Perry then asked him to "put" the engine, which was running at slow speed, a little faster. Dingle accordingly went round the building to the annexe,

* This was of course quite illegal. By the terms of their license the company are only allowed to make nitro-glycerine for ***immediate*** conversion into another explosive.

and opened the steam valve. He noticed by the "rattling" which the machine made that it was empty, and he saw Craze begin to fill it with the spud from one of the tanks. He left the trolley containing the empty buckets on the tram line about three yards from the back of the building, having been there altogether about three minutes, and walked to the change-house, which he had only just reached when, at 8.45, a violent explosion occurred in the mixing house.

Effects of explosion.

The amount of explosive in the building, so far as I have been able to ascertain, was as follows:—390 lbs. of partly mixed nitro-glycerine and nitro-cotton in three tanks; 130 lbs. of the same, partly in one of the tanks and partly in the mixing machine; 120 lbs. of nitro-glycerine in one of the tanks, and a similar amount in buckets on the floor; total, 520 lbs. of partly mixed nitro-glycerine and nitro-cotton, and 240 lbs. of nitro-glycerine, or 760 lbs. in all. In addition, there was probably a small quantity of nitro-cotton, which, in considering the nature of the effects produced by the explosion, may be neglected. The accompanying plan, No. 2, showing the relative positions of the mixing house N^1 and the surrounding buildings, has been prepared for me in the same manner as No. 1 by Mr. Guttmann.

Perry and Craze were, of course, killed instantaneously. The body of the former was scattered in fragments, while that of Craze was dismembered, the head and shoulders being found at a distance of 127 yards, in the position shown on the plan.

The building, annexe, and platform were blown to pieces, parts of the machinery and débris generally being projected in all directions. Where the building stood there was an irregular crater in the sand about 2 feet deep. The accompanying photographs, which were taken by one of the chemists at the works, show the effects of the explosion on the site and the other buildings of the factory;* and a detailed account, prepared by Mr. Bate, the chemist in charge, of the damage to the several buildings, including those forming part of the company's works but outside the licensed area, will be found in Appendix A.

It will be seen that the structural damage to other buildings was of the slightest possible character, a result which may doubtless be attributed to the excellence of the mounds with which the buildings generally are surrounded. It consisted for the most part of displaced boarding. Pieces of metal from the machinery were projected over other buildings, some even to 200 yards and upwards, and as any one of these falling through a roof might have caused an explosion of the explosive in the building and thus extended the disaster, it is obvious that the immunity from communicated explosion experienced in this instance cannot be expected on all occasions. It would, indeed, be impossible to arrange the buildings of a factory in any workable way so as to provide against all chance of communication of explosion from one to another, at any rate, from projected débris. As to broken windows, it will be seen that no less than 1,071 panes of glass were broken on the property of the company, 684 of these being within and 387 without the licensed area. No structural damage whatever was done to other property, and, so far as ascertained, only two panes of glass were broken outside the works, at distances respectively of 500 and 1,100 yards. The sound was described as very loud, like thunder or the discharge of artillery, and was heard at the Land's End, 20 miles distant.

Cause of explosion.

As both of the men in the building were killed, there is no direct evidence as to what was going on in the building at the moment. A careful examination also of the site and of the débris failed to indicate any reliable explanation of the occurrence. It cannot be expected, therefore, that the cause of this explosion will ever be ascertained with certainty. But, although the system of work generally in the factory appeared to be of a very high standard, certain points in which improvements might be made in the working came to light in the course of my Inquiry; and, as to one or other of these the accident may with some degree of confidence be attributed, it is desirable that I should consider in some detail the possible causes. To that end, the visits of the foreman and the two service waiters to the building only a few minutes before the explosion took place are very valuable, as it is possible by their evidence to fix the particular stage at which the operations in the building had arrived at the time.

It will be remembered that when Arthur Dingle was at the building (about 8.38 to 8.41) Craze began to transfer partly mixed nitro-glycerine and nitro-cotton from one of the tanks to the machine (which was running at an increased pace, Dingle having

* It has not been considered necessary to reproduce these photographs for the purposes of the printed Report.

"put up" the steam). It may, I think, be assumed that Craze was still engaged at the same operation, as it could not have been completed at the moment of the explosion (8.45). As to Perry's occupation we know nothing, except that, judging from the position in which the larger portion of his body was found, he was on the west side of the tanks. In the ordinary way, he would leave the building for breakfast at 8.45, Craze remaining till later; and he may have been preparing to do so.

When an accident happens in a building in which machinery is in motion, a suspicion naturally arises that the accident is in some way or other to be attributed to the machine; and doubtless that is very often the case. In considering the possible causes of the present explosion it will therefore be convenient to separate those connected with the machine from those not so connected. The fact that the explosive in the tanks and in the machine was warm and therefore much more susceptible to explosion by friction or percussion than at ordinary temperatures must also not be lost sight of.

Proceeding on these lines, the possible causes connected with the machine may be thus enumerated:—

(1.) Explosive in a recess in the framework of the machine below the centre cogwheel or on a tooth of a cogwheel.
(2.) Blow or friction on the machine with the spud by workmen when putting in the explosive.
(3.) Foreign substance (either from the nitro-glycerine or nitro-cotton or fallen into the trough) causing friction in the machine.
(4.) Spud dropped into the trough of the machine by man when putting in explosive.
(5.) Fracture of a tooth of cogwheel or other part of gearing or of a driving band.
(6.) Fracture or distortion of one of the revolving paddles.
(7.) Nitro-glycerine in the bearings.
(8.) Heating of the bearings.
(9.) Race of the engine.

The machine in N^1 was of course entirely destroyed, but that in the other mixing house N^2 is an exact counterpart. On examining it I found an accumulation of waste consisting of dust, fluff, woodmeal, &c. in a small recess under the centre cogwheel. As this waste possibly contained some explosive,* which, if sufficient to come in contact with the cogwheel, might be a serious source of danger, I took a sample which has been examined by Dr. Dupré. His Report, which will be found in Appendix B., is to the effect that the sample contained woodmeal and nitrate of potassium with traces of nitro-cellulose, but no gelatine dynamite. Although, therefore, some weight may be attached to (1) as a not impossible cause, it can scarcely be considered a probable one.

As to (2), viz., a blow or friction on the machine with the spud by the workman when putting in the explosive, it will be at once recognised that the use of a spud for carrying pieces of explosive from a tank to the machine (in motion) was a very crude method, and altogether objectionable; but the practice of drawing the spud against the edge of the trough, which prevailed, in order to detach the explosive (both the explosive and the trough being, moreover, heated) involved serious risk of an explosion. I think therefore that (2) must occupy a prominent position among the probable causes.

In respect of (3) it may be said that the nitro-glycerine was brought from the filtering house in covered buckets and poured therefrom into the tanks, and that the nitro-cotton was sifted and put into closed bags, which were also emptied on to the nitro-glycerine in the tanks, and every care was taken to exclude foreign substances. But in spite of similar precautions in other factories, dangerous articles have occasionally found their way into explosive in course of manufacture; and in the present instance, if a piece of metal, as for example a nail or a pin from the machinery, or some hard gritty substance was in the trough, the friction thus caused might reasonably be expected to bring about an explosion. In order to make the mixing complete the clearance between the revolving paddles and the lining is as small as possible.† Although this may be unobjectionable in a machine for kneading dough for bread, the chances of an accident are much increased when explosive is in the machine.

In the same way if (4) the spud dropped from the hands of the man feeding the explosive into the trough, friction sufficient to generate the exploding temperature might

* On one occasion a small piece of gelatine dynamite had been found in this recess
† It was stated to be $\frac{1}{16}$th of an inch only.

easily have been set up by its skidding the paddles, but I do not attach a very high degree of probability to this cause, though a possible one.

I do not think it necessary to discuss the possible causes (5) to (9) at great length. I considered them in detail in the course of my Inquiry and was unable to assign any high degree of probability to any one of them. Still they are all not impossible causes, and they could not be overlooked.

Among the probable causes connected with the machine, therefore, a foreign substance (3) in the trough holds the first place, and owing to the very small amount of clearance between the paddles and the lining, even a small substance might bring about an explosion. Next in order follows (2) a blow or friction with the spud, in putting in the explosive, which, as I have already pointed out, is a very objectionable method.

Turning now to the possible causes which are not connected with the machine, and discarding such as lightning, and other risks from without,* matches in the building, &c., which I found I could reject as having little or no weight, the list is as follows :—

(10.) The man, in transferring the explosive to the machine, may have struck the tank with the spud, or dropped the spud on the floor.

(11.) One of the men may have trodden on explosive previously dropped on the floor while transferring it.

(12.) One of the men may have knocked over a bucket containing nitro-glycerine.

(13.) Decomposition of the explosive in one of the tanks.

(14.) Quarrelling or skylarking of the men.

(15.) Intentional act of one of the men with a view to committing suicide.

In view of the fact that the explosive in the building was more sensitive to friction or percussion on account of the comparatively high temperature, it is not at all impossible that (10) a blow on the tank with the spud may have caused the explosion. The spud doubtless had explosive adhering to it, and the heat necessary to fire that explosive might be attained by a blow on the lead-work of the tank or on the floor, even in its ordinary condition. Again, the friction caused by treading on a thin film of highly sensitive explosive (11) may have brought about the same result.

As neither of the two men would appear to have been near the buckets containing the nitro-glycerine, I do not think that the accident was brought about in the manner suggested in (12).

As to (13), a sample of the explosive which had been previously received from the building that morning proved, on analysis by Dr. Dupré, to be of very good quality. No probability can therefore be attached to this as the cause. Dr. Dupré's Report will be found in Appendix C.

With regard to (14) and (15), it may be said shortly that both Perry and Craze had excellent characters, and they agreed very well together. Perry had been employed in the factory since the commencement of the work, four and a half years ago, and Craze from May 1891. So far as I could ascertain, there was no reason for supposing that either of them had any idea of committing suicide. These, therefore, may be looked upon also as improbable causes.

Reviewing all the possible causes, and comparing (2) a blow on the machine and (3) a foreign substance in the trough with the most probable not connected with the machine, viz. (10) a blow on the tank or floor, and (11), friction caused by treading on the explosive, there can be no doubt that the weight is altogether on the side of those connected with the machine. I am informed that these machines are employed on the Continent for mixing explosives of the gelatine class, and that no accident has hitherto resulted from their use ; but there can be no question that with the very small amount of clearance allowed, the liability of friction by a foreign substance between the revolving paddle and the lining of the trough to cause an explosion is not inconsiderable. Similar machines are used at Waltham for mixing cordite, but they are not heated, and the explosive is not so sensitive ; some of these are scored internally by pieces of grit or other hard substances. The immunity from explosion in their case is doubtless due to the inertness of the explosive when mixed with a solvent.

As to blame to be attached.

As there was no evidence to show definitely what was the cause of this explosion, I am unable to assign blame to anyone in respect of it. So far as I could ascertain, it was an accident.

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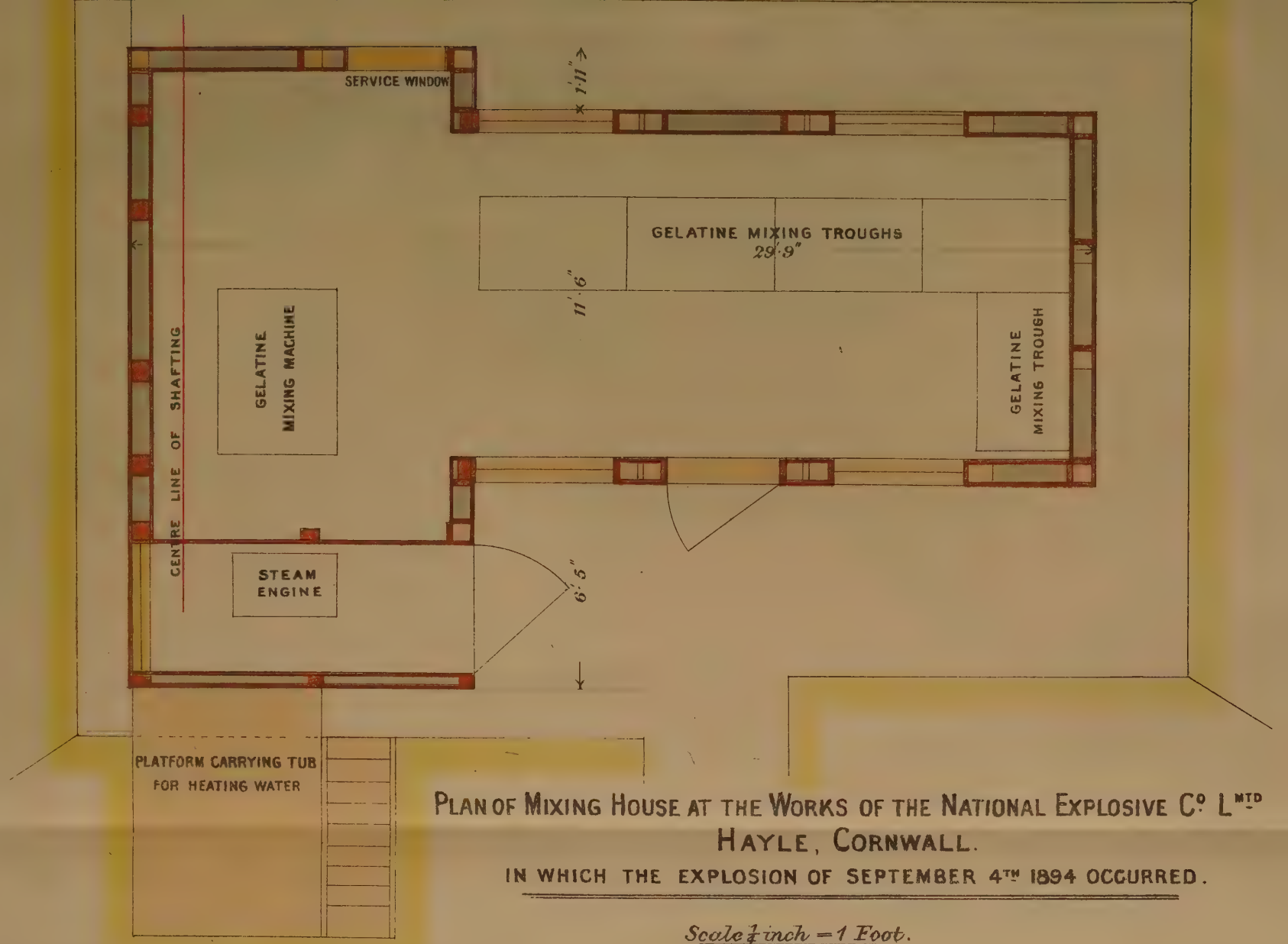
* Including the bursting of the cylinder of the steam-engine, which, as the boiler-house was distant about 500 yards, and the pressure there only 70 lbs., is too remote a contingency.



PLAN OF MIXING HOUSE AT THE WORKS OF THE NATIONAL EXPLOSIVE Co. LMTD HAYLE, CORNWALL.

IN WHICH THE EXPLOSION OF SEPTEMBER 4TH 1894 OCCURRED.

Scale ½ inch = 1 Foot.

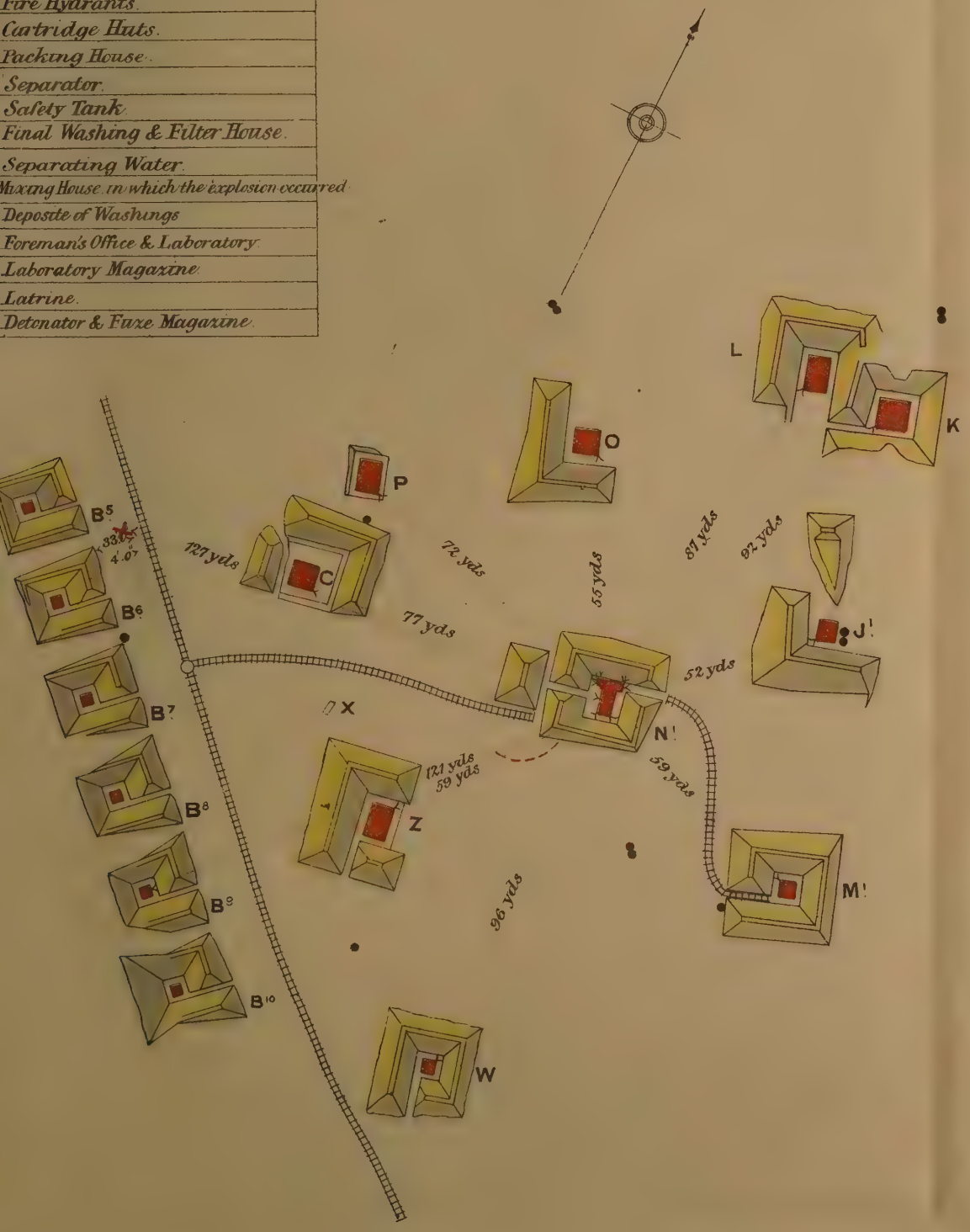
Wyman & Sons, Ltd, Lith. 63, Carter Lane. 6654. II 94

PLAN OF PART OF THE WORKS OF THE NATIONAL EXPLOSIVES Coy. Ltd.

AT HAYLE, CORNWALL.

Shewing relative positions of the Mixing House in which the Explosion occurred and the surrounding Buildings.

Position in which the body of Craze was found
Fragments of clothing worn by Craze
Tramways
Fire Hydrants.
Cartridge Huts.
Packing House.
Separator.
Safety Tank.
Final Washing & Filter House.
Separating Water.
Mixing House in which the explosion occurred
Deposite of Washings
Foreman's Office & Laboratory
Laboratory Magazine
Latrine.
Detonator & Fuze Magazine.



Scale.

10 0 10 20 30 40 50 60 70 80 90 100 Yards.

Wyman & Sons, Ltd. Lith 63, Carter Lane 8654. 11.94

Lane 5654 494

My Inquiry, however, has brought out the two following points in which improvements should be made in the course of work in the factory.

First, the illegal deposit of nitro-glycerine (which is only allowed to be made for immediate conversion into another explosive) in the mixing house from Saturday to Monday, referred to at page 5, must be abandoned. The manufacture of the nitro-glycerine should be so timed that there may be no delay in running it into the Kieselguhr or nitro-cotton, which probably it would be more advantageous to do in the filtering house than to convey the ingredients separately to the mixing house. All liquid nitro-glycerine in the mixing house would thus be avoided.

Secondly, the transfer of pieces of explosive on a spud from a tank to the mixing machine with the liability that portions may be dropped on the floor is a very defective arrangement. It has already been discussed in this Report. It can be rectified without any difficulty.

As I have already stated, the factory dates from December 1889 only, and during the first period of its existence much time must have been spent in instructing the workpeople and getting the factory into a proper routine of work. The proprietors have always been most anxious to carry out all recommendations which we have felt it necessary to make to them, and I am sure they will be only too glad to give all possible effect to the above suggestions for improvement. From 1890 to the present time, 10 visits of inspection have been made by us to the factory, and on each occasion the general condition has been reported as excellent.

I need scarcely add that I received every possible assistance from Mr. Wilkinson, the manager, as well as from Mr. Guttmann and Mr. Bate (to whom I have already referred) in the course of my Inquiry.

Coroner's inquest

I attended the inquest on the deceased, held at Hayle on the 8th September by Mr. Grenfell, Coroner for West Cornwall. He gave me every facility for examining the witnesses. The verdict was "Accidental death." The jury were of opinion that no blame attached to anyone.

I have, &c.
(Signed) A. FORD, Colonel,
H.M. Inspector of Explosives.

The Right Honourable
The Secretary of State,
Home Department.

APPENDIX A.

DAMAGE done to the WORKS of the NATIONAL EXPLOSIVES COMPANY, LIMITED, by the EXPLOSION at N[1] MIXING HOUSE, on 4th September 1894.

Outside the Licensed Area.

Chemist's House	East side, 1 pane of glass broken outwards, out of 24.
	South side, 2 panes „ „ „ 34.
Foreman's House	North side, 3 panes of glass broken inwards, out of 36.
	East side, 1 pane „ „ „ 16.
Mess Rooms	West side, 5 panes of glass broken outwards, out of 36.
	East side, 3 panes „ „ „ 36.
Office	North side, 1 pane of glass broken inwards, out of 12.
Nitric Acid Factory	South side, 40 panes broken outwards, out of 140, also 1 sash broken.
	North side, 119 „ „ „ 140, „ 4 sashes „
	East side, 47 „ „ „ 315, „ 3 „ „
	West side, no damage.
	A few slates off S.E. roof.
Guhr Mill	East side, 6 panes broken outwards, out of 16.
Laboratory	South side, 1 pane „ „ 8.
	North side, 12 panes broken inwards, out of 12, also 3 sashes broken.
Forge	North side, 13 „ „ „ 24.
	South side, 1 pane broken outwards, out of 48.
Fitting Shop	North side, 15 panes broken inwards, out of 24.
Plumber's Shop	North side, 24 „ „ „ 24, also sash broken.
Carpenter's Shop	North side, 10 „ „ „ 24.
	South side, 5 panes broken outwards, out of 48.
Wood Pulp and Nitrate Mixing House :—	
	North side, 8 panes broken inwards, out of 48.
	South side, 12 panes broken outwards, out of 48, also sash broken.
Engine House	North side, 25 panes broken inwards, out of 64.
	East side, 16 „ „ „ 32, also 1 sash broken.
	West side, 4 „ „ „ 24.
Boiler House	North side, 5 „ „ „ 36.
	East side, 5 „ „ „ 36.
Cottage	North side, 3 „ „ „ 12.

Inside the Licensed Area.

Changing Rooms	North side, 3 panes broken inwards out of 64.
	East side, 1 pane „ „ 12.
Q[1]	North side, 28 panes broken outwards, out of 32, and 1 sash broken.
	South side, 9 „ „ „ 16.
	East side, 60 panes broken inwards, out of 60, and 6 sashes broken.
	West side, 60 „ „ „ 60, „ „
	West wall moved 4 inches inwards, roof lifted, and inside boarding loose.
Q[2]	North side, 8 panes broken outwards, out of 32, and 1 sash broken.
	South side, 9 „ „ „ 16, „ „
	East side. 13 „ „ „ 60, and 1 sash blown out and 2 smashed.
	West side, 60 panes broken inwards, out of 60, and 6 sashes blown in.
H[1]	West side, 12 „ „ „ 12. and 1 sash broken.
	East side, 7 „ „ „ 12.
	South side, 8 „ „ „ 12, „ „
I[1]	North side, 16 „ „ „ 16.
	South side, 16 panes broken outwards, out of 16, and 2 sashes broken.
	West side, 16 „ „ „ 16, „ „
	East side, 16 panes broken inwards, out of 16, „ „
	Three principals of the roof cracked, and roof slightly lifted, also inside boarding displaced.
L	North side, 1 pane broken inwards, out of 16.
	South side, 14 panes broken outwards, out of 16.
	West side, 4 „ „ „ 32, and inside boarding slightly displaced.
N[2]	East side, 17 panes broken inwards, out of 36, also sash broken.
	West side, 2 panes broken outwards, out of 32.
	Inside boarding slightly displaced and roof lifted.
Engine House at D	Boarding on east side blown in.

P and Box Room	North side, 10 panes broken outwards, out of 24.
	East side, 2 „ „ „ 2.
	South side, 24 panes broken inwards, out of 24, also sashes blown inside.
	Inside boarding displaced and roof lifted.
C	West side, 1 pane broken outwards, out of 20.
	East side, 9 panes broken inwards, out of 24.
	South side, 7 panes broken outwards, out of 20.
	Inside boarding displaced and roof lifted.
Z	East side, 24 panes broken inwards, out of 24.
	West side, 18 „ „ „ 24.
	Door lock forced open, ceiling down, slates blown from east side.
K	North side, 12 panes broken outwards, out of 32, and 1 sash broken.
	South side, 23 „ „ „ 32, and 2 sashes broken.
	Inside boarding much displaced.
H^2	North side, 2 panes broken outwards, out of 12.
	West side, 6 „ „ „ 12, and 1 sash broken.
I^2	North side, 4 „ „ „ 16, „ „
	South side, 2 „ „ „ 16.
	West side, 9 „ „ „ 16.
	East side, 10 „ „ „ 16.
M^2	North side, 3 „ „ „ 16, „ „
	West side, 2 „ „ „ 16.
	Inside boarding displaced.
O	North side, 4 panes broken outwards, out of 16.
	South side, 16 panes broken inwards, out of 16.
	East side, 16 „ „ „ 16.
	West side, 16 „ „ „ 16.
	Inside and outside boarding displaced considerably and roof lifted.
M^1	North side, 16 panes broken inwards, out of 16, and 2 sashes broken.
	South side, 16 „ „ „ 16, „ „
	East side, 16 „ „ „ 16, and 1 sash broken.
	West side, 16 „ „ „ 16, and 2 sashes broken.
	Inside boarding displaced and principals of roof cracked and door broken.
B^4	East side, 1 pane broken outwards, out of 12.
B^5	East side, 1 „ „ „ 12.
B^6	South side, 1 „ „ „ 10.
B^7	East side, 5 panes „ „ 12.
B^8	East side, 4 „ „ „ 12.
B^9	East side, 5 „ „ „ 12.
B^{10}	East side, 2 „ „ „ 12.
B^{11}	South side, 1 pane „ „ 10.

The bust of Samuel Craze was found 43 yards west of the packing-house door, and one arm 100 yards west of the packing-house door.

Most of the small remains were found outside the western mound of N^1, within a radius of 40 yards.

Most of the woodwork was blown south-west, extending about 50 yards.

Most of the metal was blown eastwards, extending about 200 yards.

A large portion of the engine was found inside the north-west mound of crater.

The crater was about 2 feet deep, extending full length and breadth of the building.

One pane of glass was broken 1,100 yards south-west of N^1, and one pane of glass broken and ceiling cracked 500 yards south of N^1.

APPENDIX B.

Chemical Examination.

No. of Sample.—4340. *Date.*—September 27th, 1894.

Name of Material.—Waste.

From whom received and when.—Colonel Ford; September 18th, 1894.

General Result of Examination.—Essentially a mixture of woodmeal and nitrate of potassium, with traces only of nitro-cellulose. Would readily ignite by a spark but not likely to be exploded by a blow.

Details of Sample and Examination.—Sample wrapped in paper marked, "Waste from bearings of machine in N² house at factory at Upton Towans, 6–9–94, A. F."

Dirty looking fluffy substance, which readily takes fire when heated, but does not explode. Cannot be exploded on steel by a fall of a 2 lbs. steel weight from a height of 40 inches. Under the microscope is seen to consist mainly of woodmeal with a very small proportion of cotton fibre (nitro-cotton ?). There are also some small scales of iron rust. After drying it consisted of—

Nitrate of potassium - - - -	32·0 per cent.
Wood-meal with traces of nitro-cotton and iron oxide	68·0 „
	100·0

(Signed) A. Dupré.

APPENDIX C.

Chemical Examination.

No. of Sample.—4339. *Date.*—September 27th, 1894.

Name of Material.—Gelatine dynamite, No. 2.

From whom received and when.—Colonel Ford; September 18th, 1894.

General Result of Examination:—

Stands heat test 29 minutes.
Physical character very good.
A very good sample of gelatine dynamite, No. 2.

Details of Sample and Examination.—Sample contained in an official envelope marked "Gelignite from Factory of National Explosives Co., Limited, at Upton Towans, 7–5–94, A. F." Pale brownish, opaque, tough irregular lump of gelignite. No exudation, even after three freezings and thawings. Stands heat test for 29 minutes. A cylinder loses 0 per cent. of its height. It consisted of—

Nitro-glycerine - - -	59·64
Nitro-cotton and woodmeal -	12·24
Nitrate of potassium - -	28.12
	100·00

(Signed) A. Dupré.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING THE EXPLOSION

WHICH OCCURRED AT

MALAGO VALE COLLIERY, BRISTOL,

On the 15th March 1895;

BY

JOSEPH S. MARTIN,
HER MAJESTY'S INSPECTOR OF MINES.

Presented to both Houses of Parliament by Command of Her Majesty.

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REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON

The Circumstances attending the Explosion which occurred at Malago Vale Colliery, Bristol, on the 15th March 1895;

BY

JOSEPH S. MARTIN,
HER MAJESTY'S INSPECTOR OF MINES.

The Malago Vale Colliery is situated in Bedminster within the boundary of "the City and County of Bristol," and belongs to the Bristol Collieries Company, Limited.

Two seams are worked: "the Top Vein," which is alleged to be absolutely free from firedamp, and "the Bedminster Great Vein," which is known to give off firedamp in greater or lesser degree, but it is more especially and suddenly given off from some bad coal called "Glance Coal," which lies at varying distances above it—from 2 to 10 feet.

Since the explosion which occurred in 1891* at this colliery "the Bedminster Great Vein" has been worked exclusively by safety lamps, and shot firing is carried out by the examiners *when the men ordinarily employed are not in the mine; consequently at the time this accident occurred there fortunately were only* 14 *persons underground, viz.*, four examiners, with each of whom there was a lad for company, the hitcher, furnaceman, "dukeway rider," and three other repairers.

According to the report books, as well as the evidence before the coroner's inquiry into the case, firedamp is rarely met with, while in the level in which the accident occurred, as well as in the vicinity, there does not appear to have been any seen for considerably over twelve months prior to this explosion.

It is distinctly a "dry and dusty mine," in consequence of which, in addition to the precaution of firing shots when the men are out of the mine, the shot-lighters (examiners) are instructed to be careful to water the places thoroughly before lighting them. The manager, it appears, has had all the examiners together in his office and warned them specially on the subject within the previous four weeks, in consequence of the explosion which occurred at Timsbury on the 6th February.

Blasting with powder in any of the main haulage roads had been prohibited by the mining engineer, Mr. Batey.

Water from a small feeder in the Malago dukeway is collected in cisterns at the mouth of No. 2 level, whence it is wound up the "dukeway" from time to time; water-carts on wheels for taking along and watering the roadways as well as "jailers" (small tanks holding 6 to 10 gallons), which are sent in on trolleys or in trams, as well as buckets, are provided for conveying water to places where required.

The same disturbed and vertical coal met with in the "Argus Dukeway" at No. 8 East Level, where the explosion occurred in 1891,* has continued to the place where this accident happened, *i.e.*, a working on the lower side of No. 10 West Malago level, and which is reached by a dip "cross cut" from it.

There was some crush apparent in the place, and there were numerous cracks in the roof which may have been connected with the "Glance Coal" already referred to;

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* *See* Special Reports by Messrs. Prideaux and Martin on the explosion referred to: Vol. XX. of House of Commons Papers of 1892, page 425. [C. 6571.]

u 86809. Wt. 1161.

there were also some cavities in the roof from which the stone had fallen, and the place was also an admittedly "dry and dusty one."

The deceased fireman (Abraham) had to fire a shot charged with two cartridges of powder which the colliers left ready in the floor of this level, for the purpose of making sufficient height. Before doing so it would distinctly be his duty to examine the place carefully for firedamp, and to water the place thoroughly for a distance of 20 yards.

There seems no doubt that, had he chosen to do so, he could have obtained water, but it would naturally have delayed him in getting through his district before the men came down at 10 o'clock.

The explosion was felt about 9 p.m., and the deceased fireman and the lad who travelled with him for company were found dead close together in the level about 20 yards from the shot which had been fired. They were both badly burned.

The flame and force of the explosion fortunately did not extend beyond the No. 10 level workings, including the workings and level in which it originated on the lower side and the workings on the higher side below the next (No. 9 level), in consequence of which no other person was injured.

There were two of the examiners and their lads in the Argus workings on the return side who do not appear to have felt much, if any, force, but who were affected and rendered unconscious for a time by the effects of afterdamp, as were also several of the exploring party who went down the Argus dukeway to their assistance.

It appears that the shot was left ready for firing the previous evening, and the examiner, Edgell, who that night examined this district, tried to fire it, but failed, the fuze being, he thought, damp. The colliers, it appears, on the day of the accident pulled out this fuze and replaced it with a fresh one, and informed the overman of its having been left ready.

Edgell deposed at the inquest that before he attempted to fire the shot on the previous night he damped the place, conveying 8 to 10 gallons of water there for the purpose, and he pointed to the fact that the hole was wet and the fuze damp, which could not be gainsaid. There seems no doubt that there were appliances available for conveying water, and he said he did use some of them, although not the big tank. I consider myself that he did not sufficiently water the place, even if he did convey 8 to 10 gallons there that night, but as a matter of fact he did not fire the shot.

There is nothing to show that deceased on the night of the accident attempted to water the place in any shape or form. The large water tank was in another level. There was no sign of a "jailer" in the place, nor was there a bucket to be found nearer than the "dukeway."

On my visiting the place 15 or 16 hours after the accident there were no indications noticeable that there had been any watering done.

When examining carefully in the gutter or cavity in the roof at the upright coal, about 15 to 20 yards on the rise from where the shot was situated, I found sufficient firedamp present to explode or flash in my lamp once, but I failed to get it to do so a second time when I tried to show it to the overman.

On Monday the 18th the manager, in order to see if firedamp would accumulate, took down one of the brattice-sheets for directing the air down into this place and left it so for two hours without any gas showing itself.

In the fast corner on the lower side, the day after the explosion, I clearly found the smell of "afterdamp," such as I have found after small ignitions of gas which I have seen and which is distinctly different to the "afterdamp" smell experienced at Timsbury Colliery when in my opinion there was no firedamp present.

I also found a small quantity of firedamp in the safety lamp near the face of No. 10 level, probably 150 yds. away from where the shot was fired. In both cases they can only be said to have been traces, and they do not indicate to me that there has been any accumulation which would materially affect the explosion, certainly not account for the damage or extent of flame which occurred had there been no dust.

The shot was a distinctly badly placed one, being much too steep to allow of its doing good work. It was 20 ins. deep and had about 13 ozs. of powder. It was stemmed with the dust obtained from boring the hole, which was damped and put down with the scraper. It blew off a portion of its burden but did not properly clear the hole to the bottom.

The direction of the hole would strike the roof about 2 yds. distant, just where there were some of the cracks already mentioned and into which a safety lamp could not be inserted.

The Consulting Mining Engineer for the colliery and the other officials gave it as their opinions that the shot ignited firedamp existing in the cracks in the roof which they consider may have been connected with a cavity above caused by the sagging of the measures, and in which there would probably be an accumulation of firedamp given off from the "Glance Coal." This deceased would not be able to find in consequence of the cracks being too narrow to allow of his lamp being inserted into them.

In my opinion, judging by the position and manner of tamping the shot, along with the way in which it acted on the stone to be blasted, it would ignite firedamp if present in the cracks in the roof, and I feel satisfied that a small quantity of firedamp was kindled in the place somewhere. From anything I saw, as well as from the history of the place during the 13 months it has been driving, I could not accept the theory of such an accumulation of gas as would account for the results unless the management was absolutely incompetent, and this I am satisfied is not the case.

I, however, am not quite satisfied that *all* small quantities of gas met with and removed at once are recorded in the Report Books by the examiners, although it is clearly their instructions to do so.

It appears to me from the "dry and dusty" condition of the place that firedamp was not a necessary element for the result. In view of the circumstances of the shot in question, I believe that the deceased examiner, Richard Abraham, rather than incur the trouble and loss of time of fetching the necessary water, fired the shot where it was "dry and dusty," and that the dust alone or in combination with firedamp brought about the accident which has so unfortunately resulted in the deaths of himself and his companion, Albert Edward Walters.

Taking the evidence before the coroner as my guide, I do not think any proceedings against the Owners or Manager could be sustained, but there does appear to me to have been a serious contravention of the 12th General Rule in the matter of watering on the part of the deceased Abraham.

In concluding this report, the second which I have had occasion to make within three weeks, upon accidents occurring from blasting with powder, and in both of which cases it has only been through the fact of blasting having been done with a limited number of men in the mine that the loss of life has not been very much larger, I beg to again express my opinion with increased emphasis that *the total abolition of powder in Coal Mines is desirable*, and that where blasting is required it should be limited to the use of the most approved safety explosives fired by electricity, with further restrictions according to circumstances.

I append the report of the evidence given at the inquest, as published in the "Bristol Times and Mirror," from which it will be seen that the jury returned the following verdict:—

"Deceased were killed by an explosion of firedamp augmented by Coal Dust, "resulting from a shot fired by the deceased Richard Abraham."

JOSEPH S. MARTIN,
H.M. Inspector of Mines.

Bristol, 2nd April 1895.

(*"Bristol Times and Mirror," Wednesday, 20th March* 1895.)

THE EXPLOSION AT THE MALAGO VALE.

The Coroner's Inquest: Verdict.

Yesterday Mr. H. G. Doggett, the city coroner, was engaged for nine hours in hearing the evidence with regard to the deaths of Richard Abraham and Albert Edward Walters, who were killed at the explosion at the Malago Vale Colliery, on Friday. Those present at the inquest included Mr. J. Martin (H.M. Inspector of Mines), Mr. S. Tryon (secretary of the Malago Colliery Company), Mr. C. J. C. Prichard (solicitor to the Company), Mr. F. E. Weatherly, instructed by Mr. H. H. Gore (on behalf of the Bristol Miners' Union), Mr. S. Whitehouse (on behalf of the South-Western Miners' Federation), Mr. W. Whitefield (on behalf of the relatives of the deceased), Mr. J. Batey (expert to the Company), Mr. E. P. Wills (chairman of the Company), Mr. Wilberforce Tribe (director), and Mr. T. Bazzard (manager of the Colliery).

The Coroner addressed a few remarks to the jury, and said they were met to consider the cause of the death of the two men—Abraham and Walters—which occurred on Friday night. He did not think they would find any difficulty in ascertaining the cause of death; but they might have some difficulty in finding out how the explosion occurred. They would have to discover if proper precautions were taken, or if death was attributable to negligence on the part of anyone.

George Abraham, working at South Liberty Colliery, a miner, identified the body of his brother, who was 46 years of age. Deceased, who lived at 4, Osborne Terrace, West Street, Bedminster, was an examiner employed at the Malago Vale Colliery.

George Walters, miner, of 42, Greenway Bush Lane, stated that the deceased, Albert Edward Walters, was his son, and was 17 years old.

By Mr. Martin: His son accompanied Edgehill and Abraham on different nights in No. 3 level; the two men named were employed on alternative nights there, but deceased was constantly there to carry brattice cloth, if needed by the examiner. He did not know of any other duty for them besides examining the "faces" of the coal.

Dr. W. F. Carter, of 48, Coronation Road, said on Friday night, about 11 o'clock, he went to the Malago Vale Colliery. He found several of the men had been brought up from the pits, suffering from the effects of gas. Stimulants had been given to them, and some were sent to the Bristol General Hospital, and others that he examined were sent there. The bodies of Abraham and Walters were brought up whilst he was at the pit, and they were quite dead. The bodies were severely burnt all over, and their faces were in a similar condition. The man Abraham had a severe lacerated scalp wound, extending from the top to the back of the head. He did not find the skull injured. The boy Walters had a severe wound on the right arm, extending from the shoulder to the elbow, and it must have been occasioned by great violence; there was also a severe punctured wound on the top of the skull. He thought death was instantaneous.

By Mr. Weatherly: He had had experience in deaths from explosions, and from the appearance of the bodies he should say that a great flame must have caused it. He could not say it would be from inflammable gas, as he was not an expert. All he could say was that it must have been a very great flame.

By Mr. Martin: Medical examination could distinguish death from flame and from scalding and from his experience he should say the dryness of the burns pointed to flames having caused them.

Mr. Ralph Hope, of 1, Clyde Villas, Bedminster, stated that he was the Certificated Manager of the Colliery, and had the general supervision of the Malago Mines, special rules in connexion with which generally he produced. Immediately after the accident was over he had notice, and went down the pit about half-past ten. He found that Joseph Button, the chief foreman, had taken down a rescue party, and sent them in various directions. Sam James and Harry Vowles were brought up, and several of the rescue party were affected by afterdamp. Witness went on further and met Charles Poulteney and Henry William Kitchen and others, who were bringing out the dead bodies of Abraham and Walters. The next thing he heard was that Button and two or three others who were with him were "down" with afterdamp at the bottom of the Argus dukeway. He did not go within 200 yards of the place where the accident happened; but Edgehill informed him that Abraham had fired a shot in the dip leading out of No. 3, and it must have exploded the gas.

By Mr. Pritchard: There were four examiners in the night shift, Abraham and Edgehill being on the Malago side, and Charles Poulteney and Sam James on the Argus side. In his opinion they were all four competent men; Abraham had been an examiner for six years or so, and witness had every confidence in him. There had never been any gas reported to him in the spot where the accident happened: the district had been worked about 13 or 14 months. Witness had been down there himself, but he had not seen the slightest traces of gas. Since the explosion he had been down and found slight traces some 12 or 15 yards above the level where the shot was fired.

By the Coroner: It would be the duty of an examiner to report any trace of gas. On the night of the accident Abraham had to go round the west district, which included the place where the shot was fired, accompanied by the boy Walters, and examine all the working places to see that they were safe. If he had found a trace of gas it would have been his duty to fence the place off and

see that no one worked there, and also to water the roadways. Button, the chief overman, was responsible for ordering shots to be fired, and the examiner for the district was responsible for firing them.

By Mr. Prichard: He considered there was thoroughly good ventilation passing the place shortly before the accident, the quantity of air being 46,000 to 49,000 cubic feet per minute.

By Mr. Weatherly: If there was gas there the lamp should be properly locked; but being the firer of the shot, Abraham would have to open his lamp to do so. The boy was entirely under the examiner's orders, and had to do what he was told at all times. Once a month the mine was examined and the air registered; all reports made by examiners were entered in a report book (produced). The gas witness found after the accident was inflammable, but in a very small quantity indeed; from the presence of that gas he should infer that there was a great probability of it having been there in larger quantities before the explosion. Safety lamps were used in the mine, and they had to be kept locked. There was a lamp station in the Malago dukeway, about 600 yards from the pit's mouth. In that portion naked lights were allowed, but beyond the lamp station and through the workings they were not allowed. There was another lamp station at the top of the shaft.

Witness, in reply to Mr. Whitefield, said in his opinion it was difficult to explain the cause of the accident. There might have been some gas lodged close by; the cause of the explosion, in his opinion, was a small accumulation from the "Glance" coal, and the gas liberated by the firing of the shot was ignited thereby. The more one looked into the affair the more mysterious it was, and he did not put this theory forward with great certainty. When the examiner was found his lamp was all blown away; he believed the lamp was screwed on again, and deceased, he believed, was in the act of screwing it on in a refuge hole when the accident happened. He quite thought the gas was ignited by the shot and not by Abraham's lamp.

By Mr. Martin: The powder was taken into the mine in cartridges. On Saturday he first saw the gas, and it was only a small cap on the lamp. Experiments had been made to see if the same spot was making gas since the accident; the brattice sheet on No. 10 level had been taken down inside the air road leading down to this place for an hour and a half. The effect was to limit the supply of air, but no gas accumulated. Assuming that the gas came down suddenly, it would foul the place for some distance, and would not be driven away by the air with the sheet down. He was speaking from experience of what he knew. The air would not have been sufficient to drive it away even if the sheet were up. There was very little doubt that it was the same sort of thing that happened when there was an explosion in August 1891 at the Malago Vale Colliery, in the same sort of coal; it was on the same vertical coal, but about 300 yards away lower down. Where the gas was found on Saturday was some few yards from the face in the gutter in the roof. The place where the accident happened was habitually dry, and on Saturday, when witness saw it, it was dry, but not very dusty; the roadway leading to it was in places very dusty, caused probably by the dust blown from the sides by the explosion. Usually, when blasting in those places, water was used, and it was the duty of Abraham to use water, instructions to that effect having been given by witness himself, who, after the recent Timsbury explosion, also called all the four examiners together, and they promised to use every precaution. He impressed upon them the necessity of being very careful in the shot-firing, and pointed out the fuss there had been at Timsbury with regard to the road-watering. He had had a conversation with Mr. Batey on the subject afterwards. There were travelling water tanks provided, together with buckets and special jaylors; the tanks held about 100 gallons each, and the jaylors about two gallons and upwards. At the bottom of the dukeway water could be obtained, and the supply was from several wooden cisterns about 200 yards from the entrance to No. 10 level. He was of opinion that water was there on the night of the accident, although no travelling tank was found adjacent to the spot where the accident happened; no buckets nor jaylors were found there, and so far as he could see he could not see that watering had been done at the place where the shot was fired.

By the Jury: The distance between the place where the bodies were found and the firing of the shot was 22 yards. Under ordinary circumstances the boy would not go up with the examiner whilst the shot was being fired, but would stay back in a place of safety. The bodies were found in a refuge hole. In his opinion under ordinary circumstances, the examiner would have had plenty of time to have ignited the shot and then got back to the place of refuge where the body was found. There had never been any complaint made to witness about the way in which Abraham did his work as an examiner.

By Mr. Prichard: Walters knew that it was his duty to assist in watering the place, but he would not do so unless ordered by the examiner. If the boy knew watering had not been going on, it would be his duty to report to Mr. Button, according to Special Rule 78.

Replying to Mr. Whitehouse, witness said orders were never given directly to a boy.

By Mr. Whitefield: The boy would have to practically travel a mile with the examiner at one examination. Witness explained that glance coal was a sort of soft coal, like a mixture of shale and coal, situated above the seam at irregular distances, varying from 6 to 8 feet; but in the vicinity of disturbances it would sometimes come as close down as within 2 feet. It was in the glance coal that gas was generally found in the great vein of Bedminster coal, and in his experience it had come out sometimes suddenly and sometimes gradually. The disturbance of a shot might liberate it.

Mr. Joseph Button, of South House, West Street, Bedminster, an overman in the employ of the Company, was the next witness. He said that on Wednesday morning, with two other men, he examined the place where the accident occurred, and found the ventilation good, and there was not the slightest appearance of gas. He gave instructions to two men, named Lippiatt and Pratten, to take up the bottom of the roadway. On the following morning an 8-inch and a 6-inch cartridge were given to Lippiatt. Witness also told Abraham and Edgehill that there would be a hole to

be fired, and they were to be sure and see the place was watered and dusted before the firing of the shot.

By Mr. Whitefield: There was a slight trace of gas in a crack in the roof, and by some means, on the hole being fired, it might have caught the gas. He could put one finger in some of the cracks and two in others. Gas was there, and some had been found since the explosion. He was chief overman at the time of the last explosion at the pit, but he was not suspended.

By Mr. Martin: Gas was found after the explosion, he was told; but the inspector did not succeed in showing it to him. Lippiatt had been working as a hewer at the Malago for about eight years, and had had occasion to blow up the floor and roof on several occasions. Pratten had also had experience from time to time in the same work. Witness was not in the place at all on Friday, but work was done there by the two men named. On Wednesday the road was dry, and a little dust was there. He should say it was a place that had been watered, and of his own knowledge water was taken there nearly every day. Reports of all gas found, whether in small or large quantities, had to be made. There were no instances of gas being found in West Level No. 4, but there was a small find in East Level No. 3. After the explosion the water-buckets were found in the usual places where they were put after being used. After the explosion it was not possible for him to say whether the place had been watered.

By the Jury: If there had been a small accumulation of gas in the roof cavities it might not have been found by an ordinary examination.

John Edgehill, an examiner, of 10, Stanley Street, stated that he had been at the colliery for 15 years, and had been connected with pit work for 40 years. He or Abraham inspected the East and West Malago districts every night, and they met the night hands, after the examination at 10 o'clock, at the lamp station. On the Thursday evening witness examined the spot where the explosion took place, and found it quite safe and free from gas. The shot was put in ready for firing, and witness attempted to fire it, but could not because of a wet fuse. This was reported to Button, the chief overman. The witness watered the roadway on that evening before attempting to fire the shot. On Friday evening he was in the East district in No. 10 level, about 500 yards from the scene of the explosion, and he at once experienced a sudden shock in the air, almost immediately being overpowered by afterdamp, so that for a time he was insensible. A boy was with him, and both their lamps were blown out. Thomas Sheppard and Edward Hamblin went to their assistance, and subsequently with these they followed the afterdamp till they came to the bodies of the deceased. Abraham was on his back, and Walters was lying across his thighs. This was some few yards from the fall of the coal. The brattice sheets in No. 4 level were entirely blown away, so that witness rigged up another temporary one. The heat of the explosion was so great that, even if the roads had been watered just previously, they would have immediately dried.

The Coroner: What was the cause of the explosion?—I can't tell at all; the more I think of it the more mysterious it seems.

By Mr. Whitefield: There was sufficient time allowed for for a proper examination each time he made an examination.

Replying to Mr. Weatherly, witness said he thought there must have been some escape of gas close by Abraham when he fired the shot.

Mr. Martin: Where was the gas that you think came off?—I don't know. I don't think the place was full of gas, but only in the cracks in the roof. I cannot say for certain where it was.

Did you find Abraham's safety lamp after the explosion?—Yes, in parts.

Did you find the top of it?—Yes, the same night as I found the dead body. I found the oil pot yesterday, about 6 feet from where he was lying.

How often have shots been fired in this particular place?—Once a week, and sometimes twice, and we have gone as long as a fortnight between firing them.

Witness added that on the Monday night previous to the accident Abraham had fired a shot in the same place. There was plenty of accommodation for watering in the Colliery, and quite enough buckets. He had had a conversation with the manager since the Timsbury accident, the three other examiners being present, and they had all been cautioned as to the watering and other precautionary measures to be taken when shot firing.

Edward Lippiatt, coal hewer, working in No. 4 level of the colliery, said he had been employed by the Company on and off for eight years. On Thursday he was working with Pratten and a man named Silas Lewis, and instructions were given them by Button to put a shot hole in the floor. Powder was supplied, and Pratten charged the hole whilst witness was standing by. Edgehill subsequently told him that he could not light the hole because the fuse was damp. Witness replied, "I can't understand that, because I left it all right when I came away." On Friday, between 1 and 2 p.m., they again went to the hole, and they found the fuse was wet. They put in a fresh fuse, and, as they thought, left everything safe and sound.

Joseph Pratten, coal hewer at the Malago Colliery, was the next witness, and he bore out the statements made by Lippiatt as to having worked in No. 4 level for the last 13 months, and never having discovered any trace of gas there. He could give no opinion as to the cause of the accident.

John Batey, of Coleford, Bath, consulting mining engineer to the Malago Vale Colliery, said that he had examined the pit, and found that the shot hole was about 19 inches deep, and very steep—about 1 in 1½. This would strike the roof about two yards from the hole. The roof was very much cracked at this point by the faulty and disturbed character of the ground and the great pressure. A large fissure crossed the road there. On the level road towards the foot of the cross cut from the upper level they found traces of heat at different points. In his opinion the explosion originated at the partly blown-out shot hole, and was caused by firedamp. He thought it probable that Abraham,

on finding firedamp (if he did find it) had accumulated from some cause in the cavities and above the roll in Lippiatt's working place, on his examination, did not give time enough for the air to dilute the gases and permit the atmosphere to become sufficiently pure before firing the shot which caused the disaster. The explosion could not, in his opinion, have arisen from coal dust, otherwise it would have extended itself both outward and inward. The explosion was purely local.

By Mr. Weatherly: The fact of the shot not doing its work properly increased the risk of the explosion from gas, and he suggested that the flame from the shot caused the gas to ignite. He did not think the explosion was caused by the flame from the lamp, inasmuch as the top of the lamp was found screwed on. Not necessarily every shot gave large flame, but in most cases there was some flame, unless the ground was extensively watered. If Abraham had found the place full of gas, he ought to have fenced it off, and not fired a shot, and he believed that course would have been adopted by the deceased man.

By the Coroner: He had strong objections to the use of powder in certain parts of the mine, but not when blasting was carried on in the face.

By the Jury: Mr. Batey said he had formed no opinion of the movements of Abraham on the particular night.

By Mr. Martin: He would only go so far as to say that dust played no part in the explosion, which, he believed, was started by the gas, and as it travelled the dust on the way would increase its force. But the whole explosion from beginning to end showed very little force, as if there had been a large amount of gas it would have travelled right through the Argus workings, whereas it went only 200 yards inwards, and the same distance the other way.

Mr. J. S. Martin, Her Majesty's Inspector of Mines, in his evidence, said that on Saturday morning he was informed of the explosion and proceeded to the Colliery, where he met Messrs. Batey and Hope, and, after looking at the plans, he descended the pit in company with the two above-named and the overman Button. Mr. Batey's statement now made as regarded facts he thought to be correct. By experiment he notified the presence of gas, which he drew Mr. Batey's attention to. He tried to show the presence of gas to the others, but he was not able to do so. Witness considered the shot was put in much too steep a hole, and its not having done its work to the bottom of the hole convinced him there was probably a considerable flame given off. There were three ways of explaining the source of the explosion: one was that it might have been possibly from gas, another was that it might have been from dust, and, thirdly, it might have been from the two combined. The principal part of the explosion, he was of opinion, was distinctly due to dust. He thought there had been some firedamp ignited on account of the smell of afterdamp on the lower side of Lippiatt's face. The smell was different to that which was at Timsbury.

In answer to the Coroner, the witness said he was inclined to the view that the flame extended by dust had ignited a small quantity of gas somewhere.

By Mr. Prichard: It was one of the problems that he was unable to answer, that if dust had been the whole cause of the explosion, why the force should have stopped at the points indicated by Mr. Batey. Supposing that the explosion had been from gas, he was unable to account for its stoppage also. He could not give his opinion such as he could at Timsbury, and he was unable to specify definitely whether gas alone or dust alone was the secondary cause. The shot being fired was the first.

By Mr. Weatherly: The explosion might not have occurred if the shot had been properly stemmed, and not placed so steep. One result would have been that the flame would not have extended itself so much.

By a juryman: Probably there was sufficient dust to have caused the explosion if there had been no gas there. If the place was thoroughly watered before firing a shot, the chance of an explosion from coal dust would be of course less.

Another juryman said if the explosion had been a coal-dust one, he thought it would have followed the coal dust, and gone into other parts of the mine.

The Coroner, having summed up, said the matter narrowed itself down to a very small point, as to the cause of death, because there was no doubt it was caused by an explosion. There was, he said, no ground of suspicion against the deceased, Abraham, of negligence; but, so far as he could see, the only person upon whom they could fix responsibility was Abraham himself, who had to fire the shot. The question was, what was the cause of the explosion, and was it due to proper precautions not having been taken?

The jury, after private consultation for about 10 minutes, returned a verdict to the effect that the deaths of the deceased were caused by an explosion of firedamp augmented by coal dust, caused by the firing of a shot by the deceased, Richard Abraham.

Messrs. Whitefield and Whitehouse thanked the Coroner and jury for the consideration which had been shown them, and the inquiry then terminated.

No. CXIV.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING THE EXPLOSION OF FIREWORKS

WHICH OCCURRED AT

PRESTON PARK, BRIGHTON,

On the 5th August 1895;

BY

CAPTAIN J. H. THOMSON, R.A.,

H.M. INSPECTOR OF EXPLOSIVES.

Presented to Parliament by Command of Her Majesty.

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REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

Circumstances attending the Explosion of Fireworks which occurred at Preston Park, Brighton, on the 5th August 1895;

BY

CAPTAIN J. H. THOMSON, R.A.,

H.M. INSPECTOR OF EXPLOSIVES.

SIR, Home Office, August 26, 1895.

I HAVE the honour to report that, in obedience to your order of 10th August ($\frac{\times 54371}{3}$), made under the 66th section of the Explosives Act, 1875, I have held an inquiry into the circumstances attending an explosion (No. 79, 1895) which occurred on the 5th August 1895, at Preston Park, Brighton, whereby one person was killed, and 25 others were more or less seriously injured. I also attended the adjourned inquest held by Mr. Bush, the borough coroner.

Nature of accident.

The accident occurred during a display of fireworks given by the Ancient Order of Foresters, to whom Preston Park had been let for the day; the contract for the display having been given to Messrs. Wells & Co., pyrotechnists, of Earlsfield, S.W. The occasion being a Bank Holiday the display was largely attended, notwithstanding the fact that rain was falling in considerable quantities. The spot chosen for the purpose was a portion of the carriage drive at the upper end of the Park, and in order to keep back the spectators, a line of posts had been erected at a short distance from the road, along which a stout rope was stretched. A number of constables were employed to prevent the crowd from crossing the barrier, in the performance of which duty, I understand, they experienced considerable difficulty.

All went well until a few minutes before 9 o'clock, when the display was to conclude with the firing of several shells filled with stars from three mortars of different calibres. Two of these had been fired successfully from the smaller mortars, when Mr. Wells (junior), who was superintending the operations, lighted the fuze of a 10-inch mortar, which stood at a distance of only 6 yards from the barrier. Instead of projecting its shell into the air, this mortar burst with a loud report, and fragments of iron were projected in all directions, inflicting frightful injuries on a number of the spectators. One piece weighing about two pounds was thrown to a distance of about a quarter of a mile, and other large pieces were picked up at lesser distances. One boy was injured at 100 yards from the mortar.

The following is a list of the killed and injured persons :—

Killed and injured.

Killed.

Name.	Age.	Nature of Injuries.	Remarks.
George Henry Carpenter - -	15	Serious injury to leg - -	Died on the following morning.

Injured.

Name.	Age.	Nature of Injuries.	Remarks.
George Nutley	14	Compound fracture of skull	Very serious.
Ernest Quinn	13	Compound fracture of pelvis	Very serious.
William Wickham (in the employment of Messrs. Wells & Co.).	46	Compound fracture of thigh	Very serious.
Edward Shirwell	11	Compound fracture of both legs	Serious. One leg amputated.
Alfred Corner	27	Compound fracture of upper jaw.	Serious.
James Walkden	17	Compound fracture of skull	Serious.
Albert Paish	12	Compound fracture of ankle	Serious.
Thomas J. Smith	17	Fractured skull	Serious.
Elizabeth Crossley	48	Wound on neck	Not serious.
Ernest Crossley	9	Wound on chest	Not serious.
Joseph Newell	12	Wound on leg	Not serious.
William G. Salter	16	Wounds on head and leg	Not serious.
William Thorpe (police constable)	54	Wound on neck	Not serious.
George Jupp (police constable)	35	Injured arm	Not serious.
Bertie Parks	12	Wound on leg	Not serious.
William Noakes	13	Wound on leg	Not serious.
Edward Jobbing	13	Wound on leg	Not serious.
Howey Jobbing	15	Wounds on arm and leg	Not serious.
Edward Skinner	17	Wound on arm	Not serious.
George Parks	13	Scalp wound	Not serious.
Ernest Brales	8	Wound on leg	Not serious.
Albert Worsfold	—	Struck on right arm	Slight.
Andrew Simmonds	—	Struck on left eye	Slight.
Charles R. Neale	9	Wound in side	Slight.
Herbert Barnett	16	Struck on face	Slight.

The whole of the Brighton police have passed through ambulance classes, and the constables present were thus enabled to render aid to the wounded persons before removal to the hospital. It is probable that the loss of life would have been greater had this duty not been so promptly and efficiently attended to. It would, I think, be very desirable if ambulance instruction were afforded to the police forces throughout the kingdom, in all cases where this is not already the practice.

Cause.

It is not necessary to seek far for the cause of the accident. Notwithstanding a statement to the contrary made to me by one of Messrs. Wells' employés, I was able to obtain abundant evidence that the shell never left the mortar, and that it exploded inside. The mortar was not sufficiently strong to withstand the extra strain, and, consequently, it burst explosively, with the above deplorable results.

Description of shell.

The shell which caused the accident was manufactured in the usual manner. It consisted of two hemispheres (AA Appendix I.), formed from a number of layers of pasted paper, and joined together at (GG) with glue and calico strips glued on outside. This contained about 7½ lbs. of cubical "tail stars," the composition of which consisted of—

Meal powder	12 parts.
Saltpetre	6 „
Sulphur	8 „
Fine charcoal	3 „

The interstices between the stars were occupied by a bursting charge of one ounce of "common fire."* To the bottom of the sphere was attached a paper cone (B) to contain the propelling charge, which was about nine ounces of Curtis's and Harvey's "F" gunpowder. A time fuze (C) consisting of a stout paper cylinder rammed with mealed powder was fitted into the top of the shell and glued into position, being afterwards further secured by paper and calico pasted on at (D). A double "leader" of quickmatch (E), about two feet six inches long, was inserted in the top of the time fuze previous to firing, and two other leaders (FF) fixed to the sides of the shell served to connect the top of the time fuze to the bursting charge.

The manner of firing is as follows :—

The long strands of quickmatch having been inserted in the time fuze, their free ends are bared for a length of six or eight inches. The shell is then placed in the mortar with the cone downwards, leaving the bared ends of the quickmatch outside. These are ignited by means of a long stick. The quickmatch gives just sufficient delay to allow the man who ignites it to turn his back and perhaps move a little further away.

* Mealed powder, 16 parts ; charcoal, 2 parts.

Under ordinary circumstances the shell, with fuze alight would be propelled into the air to a height of some 500 feet and would then explode from the ignition of the bursting charge and of the stars which it contains. The ignited stars would then descend, burning out before reaching the ground.

In the present instance, however, the shell exploded at the moment that the propelling charge was ignited, and the time fuze does not appear to have acted at all. Possible causes of premature action.

It would be impossible to ascertain with certainty the cause of the premature explosion of the shell. The time fuze may have been so far defective as to act instantaneously, or it may have been accidentally pushed into the shell or have set back on the shock of discharge, the glue and paste which served to fix it having been softened by the rain. Again, the fuze may have acted all right, and the propelling charge may have been absent altogether, or may have failed to ignite from damp or other cause. I may say, however, that there is some evidence that the time-fuze did not burn out in the mortar, and that in fact the whole explosion was instantaneous.

I think, on the whole, it is more probable that the flash from the propelling charge reached the contents of the shell either through a fissure or opening in the base, or through the complete collapse of the paper walls. Possibly, the pressure to which the stars were thus subjected was sufficient to cause them to explode, instead of burning away, but it is more probable that they had been previously a good deal disintegrated by the rough usage of travelling. Stars of this composition, even when exploded, would not be as violent or powerful as an equal weight of gunpowder, and a mortar of strong construction should have easily withstood the extra strain thrown on it by the explosion of the shell.

The mortar in the present instance, however, was not a strong one. It was one of a number which were manufactured in the Royal Gun Factory, Woolwich Arsenal,* in 1856, for use in a great firework display given in Hyde Park on the occasion of the Peace Rejoicing after the Crimean War. It was, therefore, about 39 years old. Description of mortar. The construction is shown in the drawing in Appendix II. It consisted of an inner tube of wrought iron $\frac{1}{8}$ of an inch thick, lap-welded and rivetted, fixed with rivets to a cast-iron base, the upper surface of which was hollowed as shown in the drawing. The inner tube was strengthened at the muzzle by wrought-iron rings, and at the breech end by two hoops of the same material, shrunk on in such a position as to cover the joint between the inner tube and the cast-iron base. The remaining portion of the inner tube was strengthened by wrought-iron wire, $\frac{1}{8}$ of an inch thick wound on in a single layer.

This method of construction, in my opinion, presents several radical defects. The inner tube is very thin, and is therefore liable to be seriously weakened by corrosion. The longitudinal joint itself is a very undesirable feature, and the system of lap-welding and rivetting this joint is not a sound one, at any rate for the inner tube of a mortar. If the weld is a perfectly good one, its strength is lessened by providing a line of weakness in the rivet holes, whereas if the weld is imperfect, the tube is unsuitable for withstanding sudden and violent shocks, even with the addition of rivets. Moreover, there is always a tendency for the rivet holes to become the seat of local corrosion. The addition of rivets for holding the handles and for fixing the external hoops is open to similar objections. No doubt the mortars were quite good enough for the purpose for which they were originally designed, viz., for use in a single display; and they were probably constructed with a view to cheapness and lightness rather than durability.

I understand that, after playing their part in the Hyde Park display, these mortars lay idle for some 14 years at Woolwich Arsenal. Whether they were well taken care of during this period or not, I cannot say; but about the year 1870 they were sold by the Government, probably for little more than the price of old metal. This particular one, together with two others, came into the possession of Messrs. Wells & Co. some nine or ten years ago, and since then had been pretty regularly used in displays.

The life of a mortar in the hands of a pyrotechnist is a very hard one. It is constantly being transported about the country by road or rail, and thus meets with a good deal of rough usage. Moreover, when away from the factory it is exposed to all weathers, and this, combined with the fact that it is seldom or never cleaned after firing, inevitably tends to serious corrosion of the interior.

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* Careful search made in the Royal Gun Factory has failed to discover the original drawings of these mortars; it is possible, therefore, that I have been misinformed, and that they were obtained from contract and not made at Woolwich.

I have carefully examined the pieces of the burst mortar and also the sister one at Messrs. Wells' factory. I find in both cases that very considerable corrosion has taken place. The inner tube is deeply pitted, especially near the base, and is evidently much weakened thereby. The external wire is also somewhat corroded, but not to a serious extent. In the case of the sister mortar, the two rivets which held one of the handles (now broken off) have been eaten away to such an extent as to leave open holes right through the inner tube. The burst mortar, which had also lost a handle, was probably in the same condition. Obviously, therefore, the mortar, whatever may have been its original strength, had been weakened considerably by age.

Though the occurrence of the accident may be mainly ascribed to the weakness of this particular mortar, I may point out that much stronger ones have been burst by the similar premature action of shells containing coloured stars. Coloured fire compositions nearly all contain chlorate of potash; and mixtures in which this ingredient is used are for the most part liable to what is termed detonation. In the existing state of knowledge, this action of coloured stars cannot entirely be prevented, as the conditions which produce it are not fully understood.

The detonations of shells filled with coloured stars, accompanied sometimes by the bursting of the mortar, are indeed of rather common occurrence, but when unattended by loss of life or personal injury they are taken little notice of by most firework makers, and are not reported to H.M. Inspectors.

I have, however, only been able to find a record of one previous case of a mortar bursting when a non-chlorate composition was being fired. This occurred at the Alexandra Palace in 1882, when one man was killed by the bursting of a 4½-inch mortar fired with a mine of crackers.

Where a shell containing coloured stars acts prematurely in this way, the strain thrown on the mortar is very great indeed, and the latter would have to be of almost prohibitive weight if it is to be sufficiently strong as to be absolutely safe in the event of the complete detonation of such a shell.

Necessary precautions.

It is, therefore, of the utmost importance that precautions should be taken to prevent persons from being injured by such an accident, and these, notwithstanding that they would be of an extremely simple character, were, I regret to say, wholly absent in the present instance.

Pitting.

The first and most important of these precautions is that all mortars before firing should be buried in the ground at least up to their muzzles, or should be surrounded with a substantial wall of bags or boxes filled with earth or sand.

This is a precaution which is, or should be, perfectly well known to every firework maker. The necessity of its adoption was pointed out by the late Colonel Cundill, H.M. Inspector of Explosives, in his report* on a similar accident which occurred on the 25th September, 1882, and, as stated by him, it had before that time been adopted by some firework makers. Messrs. C. T. Brock & Co. have been in the habit of "pitting" all their mortars above 5½-inch calibre since about the year 1876; and they issue to their employés at every display a written notice to the effect that they will not hold themselves responsible for any injury caused by neglect of this precaution. Messrs. Pain and Sons follow a similar practice with their mortars, of 16 inch and 20 inch; but the latter firm also insist on having an enclosure for their displays of 200 yards square wherever the ground will permit. I see no sufficient reason for a limit of calibre in connexion with this precaution. The two fatal accidents in 1882, above referred to, were caused by mortars of only 3-inch and 4½-inch calibres, and though in both cases the mortars were burst by mines, I am convinced that, however small the calibre, there must always be a danger where shells containing coloured stars are fired from a mortar of ordinary construction.

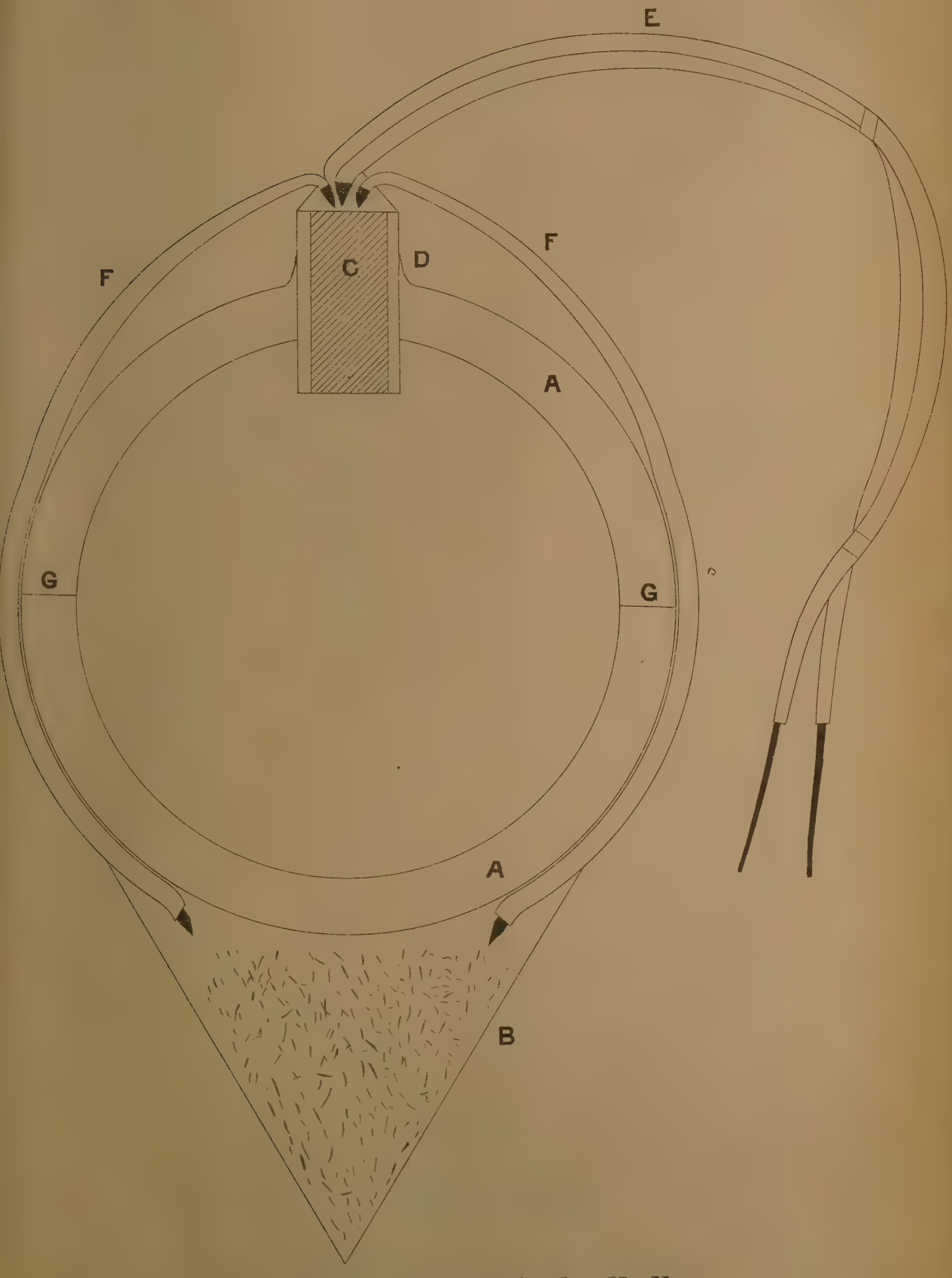
I am of opinion, therefore, that mortars of all calibres should be "pitted," or if the ground does not permit of this, they should be efficiently protected by a barricade of sandbags or earth. In places where periodic displays are given, permanent emplacements should be provided. These may consist of narrow trenches to hold a row of mortars, but in this case protection must be afforded in the direction of the ends of the trench.

Distance of spectators.

The second important precaution which should be taken, is to keep the spectators at a sufficient distance from the mortars during the display. In the present instance, the enclosure rope was distant only six yards from the mortar which burst. This was undoubtedly the cause of the large number of injuries inflicted. It is hardly to be

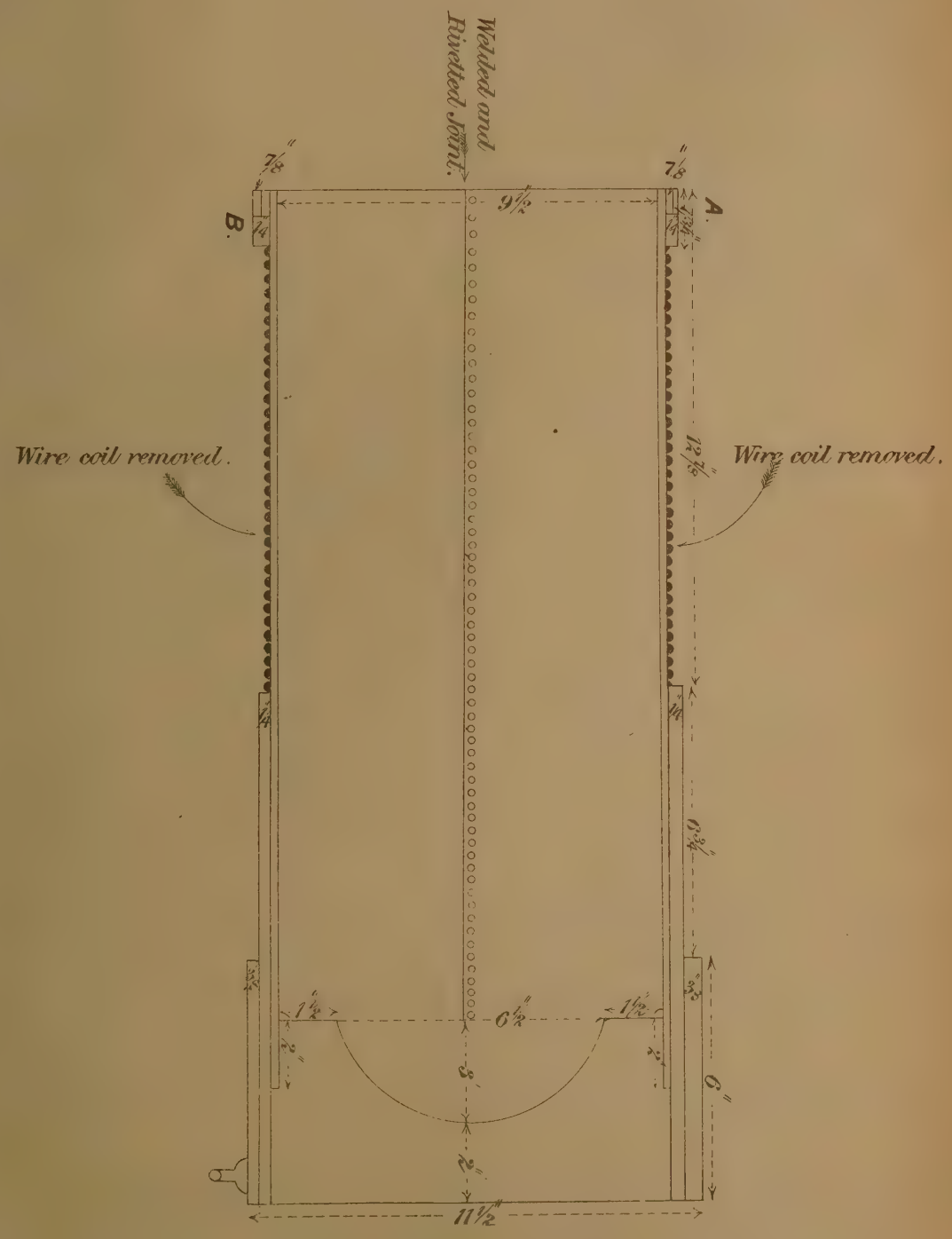
* Special Report No. XLII., dated 6th November 1882, page 7.

APPENDIX I.



Section of 10 inch Shell

Appendix II.



Mortar.

¼ Scale.

expected that the committee of management or the town authorities, as the case may be, should be alive to the extent of the danger, and it is therefore the duty of the firework maker who gives the display to insist on a safe distance being maintained, and grave responsibility must be deemed to attach to those who neglect to do so. I think that where the ground permits, the spectators should be kept at a distance of at least 100 yards, and that no firework maker should consent to carry out a public display including the use of mortars, unless a distance of fully 50 yards can be maintained. It is true that in the present instance, the pieces of the mortar were projected to much greater distances, but this would not have happened if the mortar had been properly "pitted."

I am further of opinion that it is the duty of a firework maker to positively decline to proceed with a display in the event of the spectators breaking through the enclosure and approaching the mortars.

Suggested precautions.

If the above two precautions are taken, the danger to the spectators from the firing of mortars will become infinitesimal; while to the persons engaged in the display, the risk will be largely decreased. Not only will the latter danger be still further diminished, but also it will be to the advantage of the firework maker if some precautions are taken with regard to the mortars themselves, and to the construction of the shells.

Each mortar before being taken into use should be tested by firing with an increased propelling charge, and an increased weight of shell.

Immediately before using a mortar at a display, it should be "rung," *i.e.*, struck by a piece of metal to see that it has not been cracked or otherwise seriously injured in transport.

Greater care should be taken to preserve the metal from the effects of corrosion. Thus, mortars should never be left with their bores exposed to the weather. They should, whenever possible, be washed out after use, and wiped over with oil. At the conclusion of the display season they should be painted inside and out.

It would also be of advantage if all mortars were periodically inspected by an expert, say, at the commencement of each display season, and if those which show signs of weakness were withdrawn from use.

With regard to the construction of the shell, the manufacturer should, of course, ensure that there is no crack or opening which would allow the flame to penetrate to the interior, and that the body is sufficiently strong to withstand the shock of discharge; while at the same time it should not offer too high a resistance to bursting. He should also ensure that the propelling charge is not omitted, and does not escape, or become damaged before the shell is placed in the mortar.

The fuze should be well secured, and might also be fitted with a collar of twine or paper glued on, which would prevent its setting back into the shell, even if it became loose.

The shell should never be exposed to moisture, which might tend to loosen the fuze, weaken the shell, or damage the propelling charge. The quickmatch leaders should be so arranged that it would be practically impossible for the time fuze to be ignited without the ignition of the propelling charge, and *vice versâ*. The composition of the coloured stars, especially in the larger natures of shell, should be as insensitive and inert as possible, and the stars themselves should be of such a consistency as not to be liable to get broken up in transport.

Many of these suggestions will appear to be obvious to most firework makers, but I have thought it well to enumerate them, as experience in this and other accidents in the use of explosives shows, that the most obvious and simple precautions are frequently omitted.

Question of blame.

I feel it my duty to state, that a considerable amount of blame attaches to Mr. Wells, for the omission of all precautions in the present case. That gentleman stated to me, and also at the adjourned inquest, that having never had an accident of the kind, he had perfect confidence in his mortars; and that, therefore, beyond "ringing" the metal before they left the factory, he did not think it necessary to take any precaution at all. He cannot, however, but have been aware, not only that shell detonations are somewhat common, but that serious accidents have resulted therefrom. He must also have known that many (it is hoped the majority of) firework makers "pit" their mortars; and his own common sense and experience should have been sufficient to show him that it is not safe for the spectators to be allowed to stand within six yards of these dangerous pieces, or, indeed of any large fireworks in course of being fired. While, therefore, undoubtedly, Mr. Wells is to blame, it is only fair to point

out that he is probably by no means the only firework maker who has run similar risks. It is to be hoped that a serious accident like the present one will serve to show what grave responsibilities are incurred by the neglect of ordinary precautions for ensuring the public safety.

I wish to acknowledge the valuable assistance rendered by Messrs. Arthur Brock and Arthur Pain in connexion with the inquiry.

Verdict.

The verdict of the coroner's jury was to the effect that the deceased died from the result of injuries caused by the accidental bursting of a mortar; and the jury further stated that they "recommend that the Home Office and the Town Council should pass "regulations compelling pyrotechnists, in all firework displays, to take all necessary "precautions for the safety of the public," and that they "are of opinion that there "was neglect on the part of the pyrotechnist in not taking necessary precautions "for the safety of the public, on the occasion of the aforesaid accident, as usually "adopted."

With regard to the passing of regulations suggested, it is by no means clear whether regulations fully adequate to the circumstances and of universal applicability could be passed without special legislation, as the Explosives Act, 1875, does not deal with the use of explosives; but, undoubtedly, it is important that all pyrotechnists should be brought to a full sense of their responsibilities in the matter, and Her Majesty's Inspectors are considering in what manner this object can best be effected.

Summary.

To sum up, the result of my inquiry shows:—

(1.) That the accident was due to the bursting of a 10-inch mortar, which was being fired with the usual charge, and in the usual manner.

(2.) That the failure of the mortar was due to the premature explosion of a shell containing non-chlorate stars, in its bore.

(3.) That similar premature explosions are somewhat common, and, in the present state of knowledge, cannot be wholly prevented when chlorate mixtures are used.

(4.) That the mortar was a weak one, but that there would have been danger in the case of a detonation of coloured stars, even if it had been of considerably stronger construction.

(5.) That there was a total absence of precautions for the public safety, the mortars being wholly unprotected, and the spectators having been allowed to approach within six yards of the one which burst.

(6.) That blame attaches to Mr. Wells for the neglect of these well-known and most necessary precautions.

I have the honour to be,
Sir,
Your obedient servant,
J. H. THOMSON, Capt. R.A.,
H.M. Inspector of Explosives.

The Right Honourable
The Secretary of State,
Home Department.

EXPLOSION AT QUARTER COLLIERY.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT,

BY

CHARLES J. GUTHRIE, ESQ.,
ADVOCATE,

AND

J. M. RONALDSON, ESQ.,
ONE OF HER MAJESTY'S INSPECTORS OF MINES.

ON THE

CIRCUMSTANCES ATTENDING AN EXPLOSION WHICH OCCURRED IN THE QUARTER COLLIERY, DENNY, STIRLINGSHIRE, ON THE 26TH APRIL 1895.

Presented to both Houses of Parliament by Command of Her Majesty.

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1895.

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Report on the Quarter Colliery Explosion.

SIR,

WE have now to report the result of the inquiry which you instructed us to make in terms of the following letter—

" Coal Mines Regulations Act, 1887, Section 45.

" I, the Right Honourable Herbert Henry Asquith, one of Her Majesty's Principal " Secretaries of State, being of opinion that a formal investigation into the fatal " accident which took place on the 26th April last at Quarter Colliery, Denny, " Stirlingshire, is expedient, do hereby, in virtue of the powers entrusted to me by " the said enactment direct such investigation to be held; and do hereby appoint " Charles J. Guthrie, Esquire, Advocate, being a competent person, to hold such " investigation, and J. M. Ronaldson, Esquire, one of Her Majesty's Inspectors of " Mines, being a person possessing special knowledge, to act as Assessor to the said " Charles J. Guthrie, in holding the investigation.

" (Signed) H. H. ASQUITH."

" Whitehall, 8th May, 1895."

On the 15th of May we visited the Quarter Colliery and examined all the parts of the mine in any way connected with the accident.

After due advertisement in the " Scotsman," " Glasgow Herald," and local newspapers, the inquiry was opened on 3rd June, 1895, and was concluded on 5th June. The mine-owners were represented by Mr. Graham Murray, Q.C., instructed by Mr. Stuart Foulis, Writer, Glasgow. Mr. J. Jeffrey Hunter, Writer, Glasgow, appeared for the relatives and representatives of deceased miners with the exception of John Busby, and Mr. R. Chisholm Robertson represented the Forth and Clyde Miners' Association. The evidence was recorded in shorthand; and we were satisfied that the statements of the 35 witnesses examined embraced the whole material evidence now procurable. We forward herewith the notes of evidence.*

We also forward copies of a plan,† prepared by Mr. McCreath, M.E., for the mine-owners, which was accepted by all parties as substantially accurate. The report books were also produced and an excerpt taken therefrom of the entries between 1st August, 1894, and 1st May, 1895, which, it was explained, referred to gas, is forwarded herewith.‡ The last entry of gas being found before the explosion is on 19th November, 1894. In the case of all these entries it was impossible without explanation to know whether the statement applied to the finding of gas or to a defect in ventilation or in the condition of the roof and sides.

Reports by Dr. John Joss and Dr. John H. Lumsden, Denny,§ as to the condition of the bodies of the deceased men in relation to the cause of death—whether burning by firedamp, or suffocation by after-damp, or violence by falling material—were agreed to be accepted as correct, and are forwarded herewith, along with a list of prosecutions in the Sheriff Court at Stirling for contraventions of the Coal Mines Regulation Act, 50 and 51 Vict. cap. 58, sections 49 and 51, and the special rules under the Act, committed at Quarter Coal Pit, between 6th June, 1892 and 3rd June, 1895, which was proved by the Sheriff Clerk.‖ This list includes the name of Henry McGovern, one of the men who was killed, who was convicted at Stirling on 14th June, 1892, for having a pipe in his possession, and was fined 20*s.* which sum was paid at the bar. The last offence which was prosecuted was committed on 5th March, 1894, fully 13 months before the accident. The articles found upon the deceased men were made available to the parties in the hands of the Procurator Fiscal, and the accuracy of the statements on the labels attached to these articles was not challenged. It appears from these labels that no articles involving a contravention of the Mines Regulation Act were found on the bodies of John Busby, Bernard Dunion, John McGovern, John McMillan, or Peter Tully. On the bodies of the other eight men who were killed were found the following articles :—

Patrick Carr.—Tin match-box half full of matches; and contrivance for opening lamps.

John Comrie.—Split nail for opening lamps.

Peter Conway.—Seven matches and split key for opening lamps.

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* Production No. 1. † Production No. 2. ‡ Production No. 3.
§ Production No. 4. Production No. 5. ‖ Production No. 6.

Patrick Dunion.—Split nail for opening lamps.
John Herron.—Clay pipe and piece of tobacco.
Henry McGovern.—Tin match-box half full of matches.
Robert Mitchell.—Clay pipe and piece of tobacco.
John Nicol.—Wooden pipe, piece of tobacco, one match, and a box half full of matches.

The lamps used by the deceased on the day of the accident were produced by the mine-owners.

The history of the pit, so far as necessary for the present question, is as follows :— It was sunk about 30 years ago, and the Blackband ironstone lying about 30 fathoms above the coal was at first alone worked. Then the pit was sunk to the Bannockburn Main coal seam, and from 1873–4 to 1879–80, it was worked both for coal and ironstone, and since 1878–80 for coal alone. The mine was worked partly by longwall, partly by stoop and room. At and near the place of the accident it was worked by stoop and room. At the time of the accident there were fully 170 men engaged in the pit.

The depth of the down-cast shaft is 145 fathoms to the main coal. The up-cast pit, 67½ fathoms in depth, is provided with a fan, which is of the open running type, 12 feet in diameter, and it usually ran at speed of 103 revolutions per minute, with a water gauge of one inch.

Until five years ago the mine was worked with naked lights. In 1889 the inspector desired the use of safety lamps. This was resisted by the mine-owners, but on a reference under section 47 (4) of the Coal Mines Regulation Act, Mr. R. T. Moore, the arbiter appointed, ordered the introduction of safety lamps, which have been regularly used ever since. The lamps used are known as the Protector Marsaut Lamp, burning naphtha for 16 hours. Their design as lamps is unexceptionable. They are one of the four lamps recommended by the Royal Commission of 1877. In addition to the ordinary characteristics of the Marsaut Safety Lamp they are so constructed that they cannot be opened without the light being extinguished. They appear to have been regularly kept in good working order, and all the lamps of the deceased were, after the explosion, tested in explosive gas and found to be in a safe condition. We saw no reason to doubt that the officials of the colliery were thoroughly competent for their respective duties.

Referring to the plan, which only shows part of the dip workings, the men whose lives were lost were employed either in the New Dook or in the working places to the south-west thereof. The air current for the south-west side passed down the New Dook and up the faces, as indicated by the arrows, part of the current going through the stooped waste to the rise of the horse level, part up the airway through the old longwall workings, and along the working faces to the rise; while a small portion passed up between the stooped waste and the New Dook, and joined the intake air going in the south level.

The haulage in the dip workings is done by an endless rope passing down the upper part of the Old Dook, down the north slope, across from thence to "The Slope," up which it passes and thence up the New Dook to the pit bottom. All the empty hutches go down the Old Dook, and the full hutches up the New Dook. No work was being done between the New and the Old Dooks, the return air from the men employed in the extreme dip workings passing up through these workings. The workings between the two dooks were dry and dusty, as were also the working places of the men who lost their lives in the under section of the New Dook, and most of the roadways leading thereto.

The circumstances connected with the accident may be next noticed. On the morning of the day in question, 26th April, 1895, the usual and proper examination of the pit seems to have been made by the firemen. The men, about 170 in number, were at work, when, about 1 o'clock p.m., first one explosion took place in the New Dook section, and then, at the interval of from half a minute to three minutes, another explosion in the same part of the mine. All the men, twelve in number, engaged in the workings below the Horse Level in the New Dook were killed by burning, by afterdamp, or by violent contact with material, and one man, Patrick Carr, engaged in the workings called "Martin's," above the Horse Level, was killed by afterdamp. The other men in Martin's workings escaped uninjured. The pony drawing the hutches along the horse level to the New Dook Haulage Road was living when found by the exploring party, but could not be got out alive. We are satisfied that after the explosion every possible effort was made for the rescue of the men in the section of the mine where the explosion occurred.

The cause of the accident remains for consideration.

The immediate cause was, undoubtedly, the ignition of firedamp by a naked light, the conditions of temperature being such as to exclude the possibility of spontaneous combustion. If so, how did firedamp, sufficient to cause an explosion, come to be present in the workings? and how was there a naked light in a mine where naked lights were prohibited except at the pit bottom?

The first of these questions is obviously one which falls to be answered by the mine-owners, on whom alone, in ordinary circumstances, could any responsibility rest for so dangerous a condition of matters. It was for them to show that there had been no dangerous accumulation of gas in the workings, and that a sufficient current of air was provided to render harmless any ordinary outburst of gas, even if, contrary to the rules, a naked light was present in the workings.

The place where either the first or the second explosion originated has not been absolutely ascertained. In all probability, however, it must have been either in the road where McMillan and the two McGoverns worked, or in the road where Conway and Herron worked.

It will be observed, by referring to the plan, that only a screen separated the intake air at the foot of the New Dook, and the return air from the workings to the extreme dip. On the 29th and 30th April it was found that there was an accumulation of explosive gas to the dip of this screen, and it appears that none of the officials had been in the workings immediately to the dip of the screen for a considerable time prior to the explosion. The lamp of Henry McGovern was found four yards to the rise of this screen and his body $11\frac{1}{2}$ yards farther up the dook than his lamp. There is no proof of there having been either any sudden outburst or any known accumulation of firedamp in any part of the workings, or waste adjoining thereto; but if there was gas accumulated behind the screen referred to, not necessarily in very large quantity, some of it would probably leak through the screen, and if in such circumstances any person went close to the screen with a naked light an explosion would be likely to follow. On the body of Henry McGovern, who had previously been convicted of having had a pipe in the mine, there was found a box of matches, and we think it possible that, by going down towards the screen and striking a match there, he may have been the cause of the explosion.

The explosions do not appear to have been of a very violent nature. The roof of the roads to the working places of the deceased miners in many parts fell to a height of about a foot, although in some parts it fell more heavily. Almost all the stoppings on each side of the New Dook below the relighting station were blown out in the direction of the Old Dook. In the working places of Conway and Herron the blast went towards the rise, while it went to the dip from the point where Henry McGovern's body was found. There was no evidence of force in the workings between the two dooks, although the fire must have traversed these workings, as shown by the props, screens, &c., close to the Old Dook having been set on fire.

We think it proved that a sufficient examination was made of the places of the deceased, and the roadways leading directly to them, on the morning of the accident to have revealed the presence of dangerous quantities of explosive gas had such been present, and that no such quantity of gas was, in point fact, present. We think that at the time of the accident there must have been either an outburst of explosive gas or an unknown accumulation of firedamp, either in the waste adjoining the stoops being extracted or some other part of the workings which had not been inspected by the firemen and which it may not have been necessary for them to inspect.

The chief controversy arises on the other branch of this question, namely, was there sufficient ventilation in the New Dook workings to render harmless any ordinary outburst or accumulation of gas there, even if, contrary to the rules, a naked light was present in the workings? We have found this question attended with some difficulty.

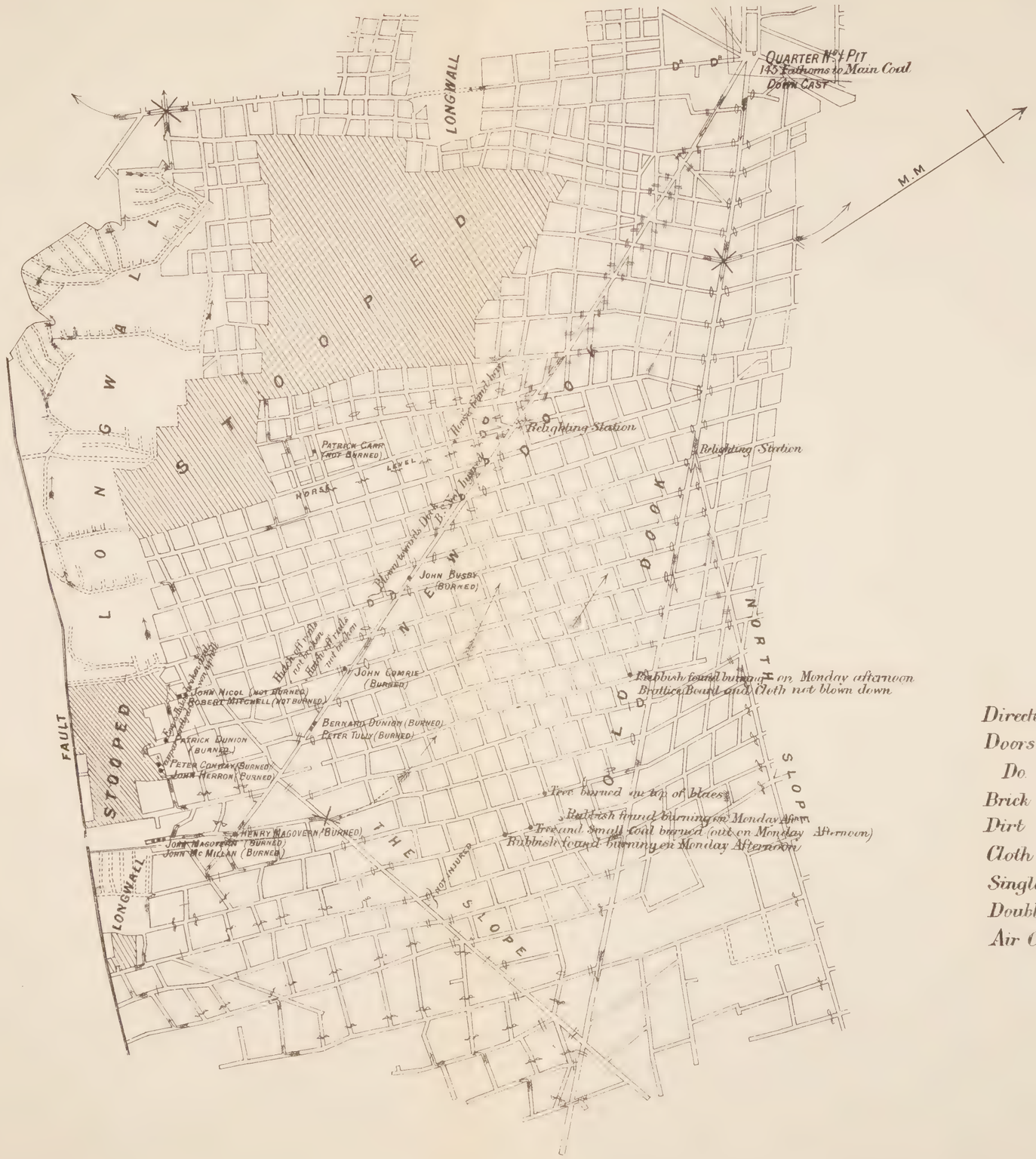
The amount of air entering the mine by the downcast shaft appears to us to have been sufficient if properly conducted through the workings. It is, of course, inevitable that a considerable amount of the air directed along the roads and round the working places should "scale" into unused parts of the mine. It has been suggested, however, that in the case of the New Dook the amount of air so "scaling" was so great as to leave an insufficient quantity for the due ventilation of the roads and places where the men who lost their lives were travelling or working. A large body of evidence was led on this point, which deserved and has received our most careful consideration. On the one side it was maintained that the dirt stoppings along the New Dook should either have been tighter, or, as has been done since the explosion, should have been replaced by brick stoppings; and that defective ventilation was proved by statements

and complaints which had been made before the explosion by some of the men who were killed as well as by certain other miners, who, it is said, not only complained, but left the work on account of this insufficient ventilation. On the other side, it was alleged that the dirt stoppings, originally carefully constructed, had had ample time to consolidate and were sufficiently consolidated; that similar dirt stoppings had been found effective in other parts of the mine, and are in ordinary use in similar situations in other mines, and that the sufficiency of the ventilation in the places where the thirteen men were killed was proved by the fact that in the longwall workings and in Martin's stoops, which are ventilated by substantially the same current, the ventilation had always been found sufficient. In our opinion, however, the mere fact of the ventilation in Martin's section and in the longwall workings to the rise thereof being sufficient is no conclusive proof that the workings where the majority of the men who were killed worked were also adequately ventilated.

At the time of the accident the mine-owners' arrangements for leading the air coming from Martin's stoops through the part marked "stooped" on the plan were not in our opinion satisfactory, seeing that the return air had to pass through the fallen waste, which might have been practically closed at any moment by a fall of roof, and which was bound to close completely as the stoops were extracted. We think it should have been possible for the firemen to ascertain by actual inspection and not merely to conclude by inference that the air was obtaining sufficient passage through the stooped portion. For a considerable time previous to the explosion the return airway appears to have been at several points very contracted in its area, and as practically the whole of the air current which reached the section where the explosion happened had to pass up this airway or through the stooped waste through which no one could travel, there could not in the circumstances have been a large quantity of air circulating. That this was the case was further confirmed by the fact that after the explosion, when attempting to reach the deceased miners, the explorers noticed that very little of the air current passed through the blown-out stoppings to the south-west of the dook, and it was feared that a fall had blocked the airway, although it was afterwards ascertained that such was not the case. At the same time, we see no evidence that there was in point of fact at the time any such obstruction there to the passage of air as to preclude sufficient ventilation in ordinary circumstances. Otherwise, the ventilating arrangements of the mine seem to us to have been satisfactory, and we are therefore led on a consideration of the whole evidence to the conclusion that the accident cannot be attributed to the absence of ventilation, which the mine-owners were bound under the Mines Regulation Act and the special rules to provide.

As above indicated, we attribute the accident primarily to firedamp, but at the same time we are of opinion that the explosion was much intensified by coal dust. This was disputed by the skilled witnesses for the mine-owners as well as by the officials of the mine, chiefly because the explosion was accompanied by least traces of fire in "Comrie's Road," where the dust lay thickest, and on the ground of the two explosions with a sensible interval between. If, as contended by the owners and some of their witnesses, the explosion was one of firedamp alone, there must have been a very large accumulation of gas for the flame to have swept across from the seat where it originated to the Old Dook and there ignited props and screens. It was not suggested that there could have been such an accumulation in the course of a return airway, and the presence of the coal dust in our opinion sufficiently accounts for the distance to which the explosion extended. The cause of the second explosion has not been satisfactorily explained, any more than the fact that while props, screens, and coal, at and near the Old Dook were ignited by the explosion, the wood on the roads intervening between the two dooks presented no appearance of fire. But we see nothing in the fact of two explosions to exclude the agency of coal dust. The first explosion may have resulted from the ignition by a naked light of explosive gas intensified by the presence of coal dust in the immediate neighbourhood; while the second explosion, however it originated, may also have been greatly intensified in its action by coal dust.

If coal dust in a dry state contributed to the disastrous result, were the mine owners to blame for the dry condition of the coal dust in the New Dook at the time of the accident? In view of the fact that, as aftermentioned, the cause of the explosion cannot be attributed to the firing of a shot, and that neither the General Rules nor the Special Rules provide for watering dry and dusty places except when a shot is about to be fired, we cannot connect any deficiency in watering with the accident. We think, however, that in all fiery pits containing, like this one, considerable areas where there is abundant coal dust not made damp by natural moisture, provision so far as


LONGWALL
STOOPED
Quarter No 4 Pit
145 Fathoms to Main Coal
Down Cast
M.M
Rebrushing Station
Rebrushing Station
Patrick Camp
(not Burned)
Horse Level
Horse Level
John Busby
(Burned)
John Comrie
(Burned)
John Nicol (not Burned)
Robert Mitchell (not Burned)
Bernard Dunion (Burned)
Peter Tully (Burned)
Patrick Dunion
(Burned)
Peter Contay (Burned)
John Herron (Burned)
Henry Nagovern (Burned)
John Nagovern (Burned)
John Mc Millan (Burned)
Rubbish found burning on Monday afternoon
Brattice Board and Cloth not blown down
Tree burned on top of blades
Rubbish found burning on Monday Afternoon
Tree and Small Coal burned out on Monday Afternoon
Rubbish found burning on Monday Afternoon
FAULT
LONGWALL
NORTH
SLOPE
SLOPE
OLD
NEW
DOOR
DOOR
DOOR

reasonably practicable ought to be made, at least in all the working roads, for artificial watering.

We have stated above that the accident must have been caused by the ignition of firedamp by a naked light; and we have now to consider the question of how a naked light came to be in the workings.

Four suggestions have been made. *First*, a shot may have been fired. We think this excluded, because, at the only place where evidence was found of a shot having been recently fired, the tools and lamps were lying much closer to the face than they would have been left prior to the firing of a shot. This makes it unnecessary for us to consider the question which was raised in the evidence of the propriety of the use for blasting in the working places of powder rather than carbonite.

Second.—A miner may have been working with a naked light or an opened lamp. The list of prosecutions does not suggest that men ever worked surreptitiously with naked lights, and the piece of wick found in the workings proves nothing; while the fact that all the lamps were found after the explosion securely closed makes it certain that no attempt had been made to open the lamps.

Third.—A miner may have struck a match to relight a lamp which had gone out. This may also be dismissed, because, before doing so, the lamp would first have been unscrewed; and all the lamps were found screwed tight and locked.

Fourth.—A miner may have struck a match, his lamp having gone out, to see where his lamp was, or to find his way out; or he may have struck a match to light his pipe. So far as it is possible to come to a conclusion the presence of a naked light seems to have arisen in one or other of these ways.

If so, the question of the construction of the lamps employed in this mine does not properly arise. We think it right, however, to observe that the evidence led in this case has confirmed the views expressed by us in our report on the accident which took place at Herbertshire Colliery, Denny, on 30th June, 1893, as to the propriety of fitting lamps, whatever their construction may be, with appliances for ascertaining whether they have or have not been opened. In this case, as already mentioned, contrivances for opening the lamps were found on the bodies of Patrick Carr, John Comrie, Peter Conway, and Patrick Dunion, four out of the 13 men who were killed. The explosion in Herbertshire Colliery was due to the habit of miners carrying matches to be used either for lighting lamps or pipes. As already mentioned, matches or pipes, or tobacco were found on the bodies of Patrick Carr, Peter Conway, John Herron, Henry McGovern, Robert Mitchell, and John Nicol, six of the 13 men who were killed.

We previously ventured to suggest in our report on the Herbertshire accident, whether the punishments by fine ordinarily inflicted in the Sheriff Court on miners offending against the regulations regarding the use of safety lamps were adequate, and whether imprisonment should not in suitable cases be inflicted. The evidence in this case and a consideration of the list of prosecutions produced by the Sheriff Clerk, 10 in number, between 14th June, 1892, and 22nd May, 1894, has deepened the conviction previously expressed. We are of opinion that in Stirlingshire it has been proved that fining the workmen for offences of this nature has no effect in making them comply with the necessary regulations for safeguarding their own lives, and that it is imperative that imprisonment without the option of a fine should be the sentence in all cases of wilful contravention. Especially in cases of second convictions, imprisonment ought to be awarded instead of fines, no part or only a small part of which may be paid by the offender himself. In suitable cases, moreover, these offences ought to be libelled by the Procurator Fiscal not only under Sections 49 and 51, but also under Section 60 of the Coal Mines Regulation Act.

On the whole matter, we have to report that in our opinion the explosion at Quarter Pit on 26th April, 1895, resulting in the loss of 13 lives, was caused by the ignition of an accumulation or an outburst of gas coming in contact with a naked light (other than an opened safety lamp) which had been unlawfully kindled, either by the fireman John Nicol, or by one of the miners who were killed. In our opinion the intensity of the explosion was aggravated and its area extended by the ignition of coal dust.

We have, &c.,

(Signed) CHARLES J. GUTHRIE,
Commissioner.

J. M. RONALDSON,
Assessor.

August, 1895.

PAPERS PRODUCED AT THE INQUIRY

HOLDEN BY

MESSRS. GUTHRIE AND RONALDSON, IN JUNE, 1895,

BEING

PRODUCTIONS NUMBERED 3, 4, 5, AND 6, REFERRED TO ON PAGE 3 OF THE REPORT [C. 7913.]

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1895.

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Production No. 3.

NOTE of ENTRIES as to GAS found between August 1, 1894, and May 1, 1895.

1. October 30, 1894 :—
   J. Connelly's place (Squire Busby, fireman).
2. November 15, 1894 :—
   D. Connell's place (Squire Busby, fireman).
3. November 19, 1894 :—
   Hannan's place (Squire Busby, fireman).
4. April 29, 1895 :—
   New dook above step (Robert Paterson).
5. April 30, 1895 :—
   New dook above step (Robert Paterson).

Production No. 4.

To PATRICK WELSH, Esq., Procurator-Fiscal, Stirling.

Denny, June 1, 1895.

I hereby certify on soul and conscience that on the 26th of April, 1895, I examined the body of John Busby, and that on the 27th of April, 1895, I examined the bodies of Peter Tully, Bernard Dunnion and Henry MacGovern, all in the carpenter's workshop at Quarter Colliery, in the Parish of Dunipace.

Post-mortem rigidity was not well marked in the case of John Busby. There were four scalp wounds on his head; also a compound fracture of the right humerus; also a compound dislocation of the middle finger of the left hand at the metacarpal joint. There was some burning on the legs and bruising of the upper part of the back behind the shoulders.

In the case of the body of Peter Tully, there were signs of severe burning all over his body. There was also one small scalp wound. Post-mortem rigidity was well marked.

The body of Bernard Dunnion also exhibited signs of severe burning all over. There was also one small scalp wound.

I found three scalp wounds on the body of Henry MacGovern; also evidence of severe burning of the regions of the head and chest, and upper part of the abdomen. The burning was slight about the legs in his case.

I am of opinion that Peter Tully, Bernard Dunnion, and Henry MacGovern died from the effects of after-damp, the result of the explosion of fire-damp in the colliery, and that John Busby probably died from the same cause, but the injuries which he had sustained might have caused death from shock on account of their severity.

(Signed) JOHN JOSS, M.A., M.B., C.M.

Production No. 5.

To the PROCURATOR-FISCAL, Stirling.

Denny, June 1, 1895.

I hereby certify on soul and conscience that on the 27th April, 1895, I examined the bodies of the following named men in the carpenter's shop at Quarter Pit:—

1. *John Heron.*—Post-mortem rigidity well marked in all the extremities. Hair almost singed completely off head. Face and neck badly burnt, skin peeling off in parts as result of burn. Both arms up to shoulders burnt, and skin peeling off in parts. Almost all of skin of both palms peeled off. Front of chest burnt and skin peeling in parts.

2. *Peter Conway.*—Post-mortem rigidity fairly well marked in all the extremities. Face, breast, hands, and arms badly burnt; skin peeling off in parts. Small laceration on right side of face close to angle of mouth. Skin readily peeled off on slightest pressure on parts mentioned.

3. *Robert Mitchell.*—Post-mortem rigidity well marked in all extremities. No external injuries on body except slight scorching between shoulders.

4. *Patrick Dunnion.*—Post-mortem rigidity well marked in all the extremities. Face, arms and hands badly burnt, with skin peeled off in parts. Small cut on right temple 1 inch long by $\frac{1}{4}$ inch deep. A few scratches over right eyebrow. Pressure marks on chest and right buttock. Left side of chest burnt and peeling.

5. *John Nicol or Trevorro.*—Post-mortem rigidity well marked in all the extremities. No external injury except scorching on back between and over shoulders.

6. *John Comrie.*—Post-mortem rigidity considerable in all the extremities. Very badly burnt all over body, except back. Skin peeling off very freely all over burnt parts. Cut over right elbow $1\frac{1}{2}$ inches long by $\frac{1}{4}$ inch deep.

7. *John McMillan.*—Post-mortem rigidity well marked in all extremities. Hair of head and moustache slightly singed, face scorched. Hands, back and buttocks badly burnt, and skin peeling off in parts.

8. *John MacGovern.*—Post-mortem rigidity well marked in all extremities. Face badly burnt and hair of head slightly singed in parts. Back, arms, and hands burnt and skin peeling. Left hip and back of both legs badly burnt.

9. *Patrick Corr.*—Post-mortem rigidity considerable in all the extremities. No external injuries except slight scorching of lower part of belly.

Opinion as to cause of death.—I am of opinion that the deceased John Heron, Peter Conway, Robert Mitchell, Patrick Dunnion, John Nicol or Trevorro, John Comrie, John McMillan, John MacGovern, and Patrick Corr died from suffocation due to after-damp, following on an explosion of fire-damp, in Quarter Pit.

JOHN H. LUMSDEN, M.B., C.M.,

Production No. 6.

LIST of PROSECUTIONS in the SHERIFF COURT at STIRLING, at the instance of the PROCURATOR-FISCAL, for CONTRAVENTIONS of the Coal Mines Regulation Act, 50 & 51 Vict. c. 58, sections 49 and 51, and the Special Rules under the Act, committed at Quarter Coal Pit, Dunipace, between June 6th, 1892, and June 3rd, 1895.

Name of Contravener.	Occupation.	Offence.	Pit where Offence Committed.	Date on which Offence Committed.	Date of Conviction.	Place of Trial.	Sentence.
Henry McGovern	Miner	Smoked, or had in his possession a pipe for smoking.	Quarter Pit	6 June 1892	14 June 1892	Stirling	20*s.* paid at bar.
Joseph Sneddon	Miner	Fired a shot, he not being a competent person for that purpose.	Quarter Pit	13 Oct. 1892	1 Nov. 1892	Stirling	20*s.* paid at bar.
John Mullan	Miner	Smoked, or had in his possession a pipe for smoking.	Quarter Pit	31 Oct. 1892	Cited to appear on 28th March 1893, but failed to appear, and warrant granted to apprehend him.		
Henry Brady	Miner	Had in his possession a box containing lucifer matches, and a pipe for smoking.	Quarter Coal Pit.	9 Dec. 1892	Cited to appear on 10th January 1893, but failed to appear; continued to 17th instant, again failed to appear, and warrant to apprehend granted on that day.		
James Hughes	Miner	Smoked, or had in his possession a pipe for smoking.	Quarter Coal Pit.	19 April 1893	2 May 1893	Stirling	20*s.* or 14 days.
Alexander Dunnion	Miner	Smoked, or had in his possession a pipe for smoking.	Quarter Coal Pit.	11 Sept. 1893	2 Oct. 1893. Convicted of smoking.	Stirling	2*l.* paid at bar.
John Brady James Brady	Miner Miner	Rode on a hutch without the permission of the manager.	Quarter Pit	20 Nov 1893	14 Dec. 1893	Stirling	20*s.* or 10 days. 20*s.* or 10 days.
Thomas Madden	Miner	Smoked, and had in his possession a pipe for smoking.	Quarter Pit	9 Jan. 1894	23 Jan. 1894	Stirling	2*l.* paid at bar.
Edward McFalls	Miner	Had in his possession a pipe for smoking.	Quarter Coal Pit.	5 Mar. 1894	22 May 1894, after warrant granted to apprehend.	Stirling	10*s.* paid at bar.

THOMAS J. GALBRAITH,
Sheriff Clerk.

Sheriff Clerk's Office, Stirling,
3rd June 1895.

EXPLOSION AT TIMSBURY COLLIERY.

REPORTS

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING AN EXPLOSION

WHICH OCCURRED IN THE

TIMSBURY COLLIERY,

On the 6th February 1895;

BY

J. ROSKILL, Esq.,
BARRISTER-AT-LAW,

AND

JOSEPH S. MARTIN, Esq.,
HER MAJESTY'S INSPECTOR OF MINES.

Presented to Parliament by Command of Her Majesty.

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REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

Circumstances attending an Explosion which occurred in the Timsbury Colliery, on the 6th February 1895;

BY

J. ROSKILL, Esq.,
BARRISTER-AT-LAW.

On Wednesday, February 6th, 1895, shortly before 9 o'clock in the evening, an explosion occurred in the Timsbury Colliery, which is owned by Samborne, Smith and Co. As appears from the plan, and from the section showing the seams that are worked in this mine, there is an up-cast and a down-cast shaft both at Lower Conygre and at Upper Conygre, the distance between them being 1,127 yards. The Upper Conygre pit has been worked for 70 years, the lower one for about 50 years.

Radstock coalfield.

The Radstock coalfield consists of three series of seams, of which the upper series only is worked at Timsbury. The second series lies at a depth of about 100 fathoms below it; and there is also a considerable distance between the second and the lowest series. The seams of coal in the upper series, as worked in this colliery, are five in number, and are known as the Great Vein, Top Little Vein, Middle Vein, Slyving Vein, and Little Slyving Vein, their depths below the surface being respectively 152, 166, 171, 181, and 188 fathoms. There is only one road along which coal from any of these veins can be sent in trams to the shafts at Lower or Upper Conygre; and there is connexion between and access to the veins and this road by means of inclines or "gugs," as shown more particularly on the section (*see, e.g.*, Wyatt's and Parnell's Inclines). The road, as appears from the plan, begins at a depth of 166 fathoms on the Top Little Vein at Lower Conygre, then crosses a 14 fathoms fault, and proceeds due north along the Great Vein through a 70 fathoms fault up Peter's Incline; and passing along the Slyving Vein and what is known as the Bottom Little Vein (where the stables are), ends at Upper Conygre, at a depth of 171 fathoms. This "through road" is also indicated on the section by a double line. There are no engines below, and it is therefore doubtful whether it can be said to be a "main haulage road" within the meaning of the Coal Mines Regulation Act, 1887, which, by s. 49, General Rule 12 (*k.*), defines a main haulage road to be a road which has been, or for the time being is, in use for moving trams by steam or other mechanical power.

Description of mine.

Plan.

The plan, which has been prepared from the working plans of the colliery, does not purport to show its entire extent, nor to indicate with completeness the whole of the portion worked, as the mine goes beyond the Lower Conygre pit in a southerly direction; but, for the purpose of the present inquiry, it contains all the information necessary or relevant to a proper understanding of the nature and dimensions of the colliery. The faces and present workings on the several veins are clearly indicated, and also an extensive area, about 34 acres, of old workings on the Great Vein, which have been closed for 36 years, and lie on the west side of and adjoin the through road, as it passes along the Great Vein. There are other old workings which are not specified on the plan and are not material. The portion marked red shows the extent of the explosion; beyond the points thus indicated, *e.g.*, on the Top Little Vein road, and on the north branch road at a distance of 660 yards from the Upper Conygre pit, its effect is not noticeable, nor are there any signs of force; and it is remarkable that the places where the course of the explosion thus came to an end are dry and dusty. The mine as a whole is not dry and dusty; in the opinion of Mr. Martin, the Inspector

Extent of the explosion.

The mine not dry and dusty, as a whole.

of Mines for the district, and, according to the manager, Mr. Foot, very much less than one half of its extent can be said to be so.

Naked lights used.

In this colliery, as throughout the upper series of the Radstock coalfield, naked lights are used; it is exempted by order of the Secretary of State from the application of so much of General Rule 12 (s. 49 of the Act of 1887) as prohibits explosives being taken down except in cartridges, and gunpowder alone is used for blasting. This is kept in a store, above ground, which, according to the under-manager (J. Treasure), never contains more than 3 cwt. The powder, when required, is supplied by the bailiffs or overmen, of whom there are three, all certificated, to the men appointed to fire shots, of whom there are no less than 50. Of the whole number, 187, employed in the colliery, about 60 are coal breakers, and it seems to be the custom in this district that, if a man is experienced as a coal breaker, he is allowed to fire his own shots; indeed this would be part of his ordinary work. The manager or the under-manager and bailiffs judge of the competence of men to act as shot firers, and, if satisfied, sanction their appointment, which, however, is not made, in general, without first obtaining the permission of the manager himself. None of these appointments are in writing, nor is there any entry in the books kept at the colliery of those men who are so authorised to fire shots. The ordinary charge of powder used in this mine is not more than half a pound, and the powder boxes do not contain quite 5 lbs. It is the general practice in the district not to bring up again any of the powder that remains unused; it is left below in tins, which are placed by the men in small holes in the wall, by their working places. It is apparently considered safer to do this than to take the powder back to the store, and, having regard to the use of naked lights, there seems to be some ground for this opinion. This practice cannot, I think, be said to amount to a storing of explosives in the mine, within the prohibition contained in General Rule 12 (*a.*) (s. 49, Act of 1887.) After the explosion 3 lbs. of unexploded powder were found in Barnes' Road, in the Top Little Vein workings, and two empty powder boxes at other places.

Gunpowder only used for blasting.

Number of men authorised to fire shots.

Small quantities of powder left in mine.

Rule 73 of the Special Rules in force in the colliery contains instructions with regard to shot firing, and concludes thus :—"If the place where a shot is to be fired is dry and "dusty, no shot shall be fired in such place except by or under the direction of the "competent person appointed for that purpose, who shall see that the provisions of "General Rule 12, sub-sections (*f.*), (*h.*) and (*i.*) are duly observed before such shot is "fired"; and on every occasion when a shot had been ordered to be fired the under-manager gave instructions with regard to the precautions to be observed. If the place was dry and dusty, the roof and sides, in addition to the floor, were always sprinkled and watered from buckets before the shot was fired; but, apart from shot-firing, the roofs and sides were not damped when the mine itself was watered, which was done sometimes weekly, sometimes at intervals of a fortnight, by means of tanks or "jailors" taken about on wheels. The roadways were swept and dust was cleared at least once a week.

Watering.

Certain portions of the mine are naturally damp; for instance, near the bottom of Peter's Gug the roadway is always wet, owing to the exudation of water from the fault there.

Ventilation.

Since the explosion at the New Pit, Camerton Colliery, near Radstock, on the 13th November, 1893, much more attention has been paid in this mine to keeping the roads clear and well watered, as well as to the ventilation. On the night of February 6th, about 8,000 to 10,000 cubic feet of air per minute passed along the through road, at a velocity of at least 4 to 5 feet per second. Indeed, owing to the exceptional cold that evening (the thermometer in the wheel-house, *i.e.*, under cover, registered four degrees of frost), and to the dryness of the atmosphere, the velocity was probably 6 feet per second.

Nature of the coal-dust in this mine.

In the manager's opinion the coal dust, in such parts of the mine as are dry and dusty, is not pure coal dust, but is mixed with shale and clay, and is too heavy to float with the ordinary current of ventilation. Mr. Batey, the mining engineer, who gave important evidence on behalf of the owners, said that he had frequently been over the through road, and the only portion he considered dry and dusty was at the top of Peter's Gug; he agreed with the manager's opinion as to the nature and quality of the coal-dust there. Three cwt. of coal-dust from seams in this district were sent some time ago to Mr. Hall, the Inspector of Mines, and he reported that, with $1\frac{1}{2}$ lbs. of gunpowder, and 2 cwt. of the coal dust, no explosion resulted. (*See* Mr. Hall's Report to the Royal Commission on Explosions from Coal Dust in Mines at page 12.)

After the explosion, and in consequence of it, the roads in this mine were much more dusty than before.

At the time of the accident nine men were in the mine. Two of them, George Flower, an examiner, and John Fear, labourer, who were engaged in clearing and "dipping" water near the west or down-cast pit at Lower Conygre, on a portion of the roadway not shown on the plan, and to which the force of the explosion did not extend, were uninjured, and gave evidence at this inquiry. The other seven were killed; their names are James Carter, John Keeling, George Sperring, James Durham, George Harding, Joseph Bridges, and John Gage; and the places where their bodies were found are shown on the plan. The adjourned inquest lasted three days; 18 witnesses gave evidence in the course of the proceedings, at which the owners of the colliery, the Somerset Miners' Association, and the relatives of the deceased men, and also the Miners' Federation of Great Britain, were all represented.

Nine men in the mine when the explosion occurred; two of them uninjured, seven killed.

On the 5th February, the under-manager gave orders to the bailiff, S. Lewis, to have a piece of rock in the roof of the through road blown down, in order to increase the height of the roadway, that portion of the roof having become very low. A shot hole, 13 inches long, had been bored there some years ago, and had now only to be charged; four inches of its length, and not more, would be occupied by the charge, and the rest would consist of clay tamping. The hole had been bored upwards, in the direction of Lower Conygre, its inclination in-by being downwards, at an angle of about 1 in $4\frac{1}{2}$. The place is shown on the plan; it is in the through road, where the word "shot" is marked in red, and is at a distance of some 70 yards from a man-hole (also indicated), near the bottom of Peter's Gug. Other shots had very recently been fired in the same portion of the mine. On the 2nd February, C. Bridges, a brancher and general repairer, fired a shot on a new siding at Lower Conygre, about 20 yards from the man-hole referred to. Two shots on January 30th, and a third on February 2nd, were fired by F. Flower, a miner, in a new turning of the through road, and about 30 yards from the place where the shot-hole in question was ordered to be filled and fired on the 6th February. The roof is natural roof in this part, and consists of smooth stone; the place is neither dry nor dusty; water lodges in a cavity in the fault, about 40 to 60 yards away. The under-manager and bailiff examined the place on February 5th, in anticipation of the shot being fired, and said that the road, roof, and walls were damp and free from dust. On January 29th, 200 to 300 yards of that roadway, including portions of the Great Vein Road and Peter's Gug, had been watered by G. Flower and T. Fear. Flower was again in that part of the mine on February 4th, and said that if he had then swept the whole extent of the side of the road that he had watered on the 29th, he would not have obtained half a barrow full of dust. On the night of the 5th, C. Bridges examined the place where the shot was to be fired; he said it was not dusty and not quite dry. It appears that, between January 29th and the night of the explosion, less than 50 tons of coal passed along the through road; this occurred on February 5th, and would probably not make the road dusty. Both the manager and under-manager stated that there was no coal dust for a distance of 100 yards away (up Peter's Gug), and that the place required no watering on February 6th. Having then received instructions that the shot was to be fired, the bailiff, S. Lewis, between 7 and 8 on the evening of February 6th, told James Carter to charge and fire it, and also told Gage, an examiner, to examine the place. Carter was an experienced man, who had been for several years employed in this colliery, and was accustomed to fire shots. George Flower has seen him do this, and said he did it in a workman-like manner. At about 8 o'clock the seven men went down the Lower Conygre shaft, Carter to fire the shot, the others to prepare and examine the workings for the next day's work and to do repairs. G. Flower and T. Fear were already in the mine when the other seven descended. Flower was close to the bottom of the shaft then and gave Carter his tools. Harding (one of those killed) was present. Flower's evidence as to what then occurred is as follows:—"We had a conversation "about the stuff to be used for ramming, and Harding told him (Carter) he could get "some clay at the bottom of Peter's Gug. I warned him not to use clay with oil in it. "There was clay there which was saturated with oil which had dripped from the trams, "and also contained coal dust. I used it at Camerton over 20 years "ago, and it filled the heading with flame. There was other clay at the bottom of "Peter's Gug (and opposite the man-hole), suitable for ramming; it is in a fault there, "from which water is always exuding." Carter left Flower; by the latter's watch it was then 24 minutes to 9; and he and Fear proceeded to their work near the West Pit. Shortly afterwards they noticed smoke, and a brattice door move, but heard no noise. They proceeded towards the through road, but could not, after repeated attempts, get further than about 40 yards, owing to the smoke; they therefore went to the shaft at Lower Conygre and signalled. J. Treasure and S. Lewis (the

Shot fired on 6th Feb., place not dry or dusty.

Clay tamping.

under-manager and bailiff) were then descending this shaft already, having learnt from Sage, the engine driver at the Upper Conygre pit, that something was wrong. Shortly before 9 o'clock Sage was in the candle-room, within three or four yards of his engine at Upper Conygre, when he heard a noise and saw smoke coming from the top of the pit, but no flame; the smoke was thick with dust. He immediately informed the under-manager, who, on reaching the bottom of the shaft at Lower Conygre with Lewis, found Flower and Fear. The four then went along the through road; the first indications they noticed was a tram turned over on its side; near it were Carter's tools, about 40 yards out-by of the shot. In the man-hole at the bottom of Peter's Gug they found Carter's body in a kneeling position, with his face towards the wall. His hair was burnt, and there was a wound on the right temple. Near the body were two lumps of oily clay, one about four or five lbs. in weight, the other smaller. The shot, they found, had been fired and had dislodged the rock there. On proceeding up Peter's Gug they were stopped, owing to the heavy falls, and therefore returned by the Lower Conygre shaft to the surface. Here they found the manager and four men, who came immediately on hearing of the explosion, and they all descended the shaft together and endeavoured to clear the falls. There were large quantities of dust. With the view of reaching the six men who had gone down with Carter, the manager went up again with a few others, and tried to descend the Upper Conygre pit. On arriving there they found volumes of foul air ascending the winding shaft, impregnated with a smell of burning wood, and that the machinery of the winding-engine would not work. Sage, the engine-driver, could not pull the cage up the shaft; three teeth were off the small cog-wheel of the engine, and two off the large one. He thought this must have been caused by the cage being forced up some distance through the explosion, and then suddenly falling back, indicating force *inwards* from the shot at Lower Conygre. As it was thus impossible to descend the Upper Conygre shaft, they returned to Lower Conygre and went down again. By this time the under-manager and those with him had got through the falls in Peter's Gug, at the top of which they found several trams wrecked and the drum broken. Owing to the foul air they could not proceed up Wyatt's Gug, but eventually reached the Top Little Vein workings. Here they found Durham's body, which bore traces of severe burning; further on they came upon the bodies of Gage slightly burnt, with a wound on the head, and of Bridges and Harding. The last two were five yards apart and badly burnt.

Indications after the explosion.

In consequence of the heavy falls the Upper Conygre pit was only reached next morning. At the stables there, 80 yards from the shaft, the wood was blown down; the body of one horse was in the through road; those of three others were in the stalls, and were singed. After this, Keeling's body was found near the bottom of the downcast shaft; his skin was burnt, and his clothes were torn away, part of them being found 15 yards off; one leg was contorted, and apparently broken; Sperring's body was near, and also burnt.

There is neither contradiction nor discrepancy in the evidence with regard to the indications of force observed after the explosion. Out-by of the shot there are few signs of any violence; such as they are, they show the direction of the force there to have been outwards (towards Lower Conygre). An old road on the Great Vein, near the 14 fathoms fault, which had been walled up, was opened, the masonry having been blown into the through road.

Direction of the force.

Between the shot and a point in-by of it half-way up Peter's Gug, very little damage was done. Two empty trams at the foot of the Gug and four others on a new siding close by were not injured, but an old and disused Great Vein Road, about 14 yards in-by of the shot, was exposed, part of the pack-wall having been blown away. This road is part of the old Great Vein Workings previously referred to, which have been closed for 36 years, and are shown on the plan. Eighteen feet in-by of the shot on the through road, a cavity was discovered over some timbers extending 12 feet inwards, its width being very nearly that of the road, and its depth at the highest point 4 feet. Mr. Batey, who examined the workings on the 7th, 16th, and 22nd February, is of opinion that this cavity is partly connected with the entrance to the old road in the Great Vein, which, as above stated, had been opened by the explosion, and is only a few yards in-by of the cavity. Some coal-dust and débris was found lodged upon the timbers under the cavity, of which the existence was unknown to the management prior to the explosion; nor was it easily observable, as the timbers were practically tight, being placed quite close, although there was a hole in them large enough to admit of a man's head passing through it. Mr. Batey does not consider it unsafe to have a cavity of this size in a mine. The line of the shot would strike the ground at a point 24 feet 9 inches distant,

Two disused roads on old workings exposed.

Cavity discovered near place where shot was fired.

the inclination of the shot-hole being about 1 in 4½, *i.e.*, immediately below the centre of the cavity.

In certain portions of the mine, especially along the Top Little Vein road, not far from the Upper Conygre pit, large quantities of fine coal-dust had been swept by the explosion. Along the North Branch road its effects became less noticeable, and at a distance of 660 yards from the Upper Conygre pit its course came to an end, although, as already mentioned, the road is dry and dusty at that point. From a point about 80 yards in-by of the shot, the direction of the force was inwards up Peter's Gug; thence again inwards up Wyatt's Gug towards the faces on the Top Little Vein workings, which are about 140 feet above the level of Peter's Gug. In this portion of the mine, where the four bodies were found, the force of the explosion was very severe; trams were wrecked, the iron-work being twisted; the ventilating doors were blown from 12 to 26 yards inwards; one tram was completely wrecked and blown inwards as much as 33 feet. At the corner of the road leading to a place called Flower's Dipple, on a door and on some props there, were discovered, what, in Mr. Batey's opinion, were the first traces of *coked* dust. This point is marked on the plan.

Firing of shot must have been direct or indirect cause of explosion.

It is thus clear that, as there are few signs of force along the distances of roadway 50 yards out-by, and 80 yards in-by of the shot, and as outside this neutral space the indications are all out-by, and inside it are in-by, the centre of the explosion must have been near the shot, and the firing of the shot its direct or indirect cause.

There are two further points of importance connected with the firing of this shot by Carter; the first is with regard to the amount of powder used, the second as to the nature of the shot-hole and the rock immediately adjacent.

On the 2nd February a box containing about 3 lbs. of powder was taken down the mine by direction of the bailiff, S. Lewis, who told a man called Hayward to take it to his working place on the east level in the Top Little Vein. Before this was done, Hayward and C. Bridges put 1 lb. of the powder into a tin, which they left at a place about 35 yards from the shot-hole. Bridges had been ordered by the bailiff to fire this shot, but owing to want of time was unable to do so; and the tin containing the lb. of powder was used by Carter on the 6th, and was found along with his tools about 40 yards out-by of the shot-hole; not more than "half a thimblefull" of unexploded powder, in the words of the bailiff, was then in the tin. Now, nothing approaching 1 lb. of powder could have been placed in the shot-hole, which was only 13 inches long and 1¼ inches in diameter. It may be that, as the hole inclined downwards, some of the powder trickled out while it was being charged, but this would not account for the greater portion of that supplied to Carter. Not more than 5 or 6 ounces could be efficiently used in the charge; even if the entire length of the hole had been filled with powder, it could not have contained more than 11 ounces. The tin was produced at the inquiry; it had been knocked about and injured by the explosion, and probably most of the powder left in it had thus been lost. I am of opinion, therefore, that the fact of the tin having been found almost empty does not, under the circumstances, show that the shot was overcharged. But the nature of the rock close to the shot-hole seems rather to indicate that it was.

Probability that shot may have been overcharged.

Since the explosion it has been discovered that there must have been a "close joint" in the rock at a distance of one inch beyond the end of the shot-hole, *i.e.*, a slight *internal* cleft only, and not a fissure that could have been noticed before the shot was fired. A portion of the rock was blown down by the firing of the shot, and the hole was broken; no traces of powder or tamping were perceptible, but the "plain face" on the edge of the rock shows that there was a joint there. In consequence, the effect of the charge would be weakened, and it would not exert the whole amount of force in an inward direction that it was expected and intended to do; this would really cause the shot to have been unknowingly overcharged and the flame to go outwards, although it was by no means a "blown-out" shot. This part of the case is of great importance in endeavouring to ascertain the cause of the explosion, as, in Mr. Martin's opinion, there may have been some dust near the shot and between it and the cavity; and owing to there having been more powder in the charge than would have been inserted if Carter had or could have been aware of the joint, a larger flame was thereby created which ignited the dust. According to this view then, it was a coal-dust explosion caused by direct ignition of the dust. Mr. Martin said further, that the appearance of the mine after the disaster was similar to that at the Camerton explosion in 1893, which is generally considered to have been due to the ignition of coal-dust by the flame from an overcharged shot. (*See* extract from Mr. Martin's report to the Secretary of State, cited in the Second Report of the Royal Commission on Explosions from Coal-dust in Mines at page xvi.). In the Camerton case—the same veins are

Joint in the rock.

The inspector's opinion.

worked in that colliery as at Timsbury—there was a joint 3 inches beyond the shot-hole, which was a very short hole, only 10 inches in length, and the result was that it was overcharged "with half to three-quarters of a pound of powder." (*See* Mr. Martin's Report, *supra*). There is, however, some, though not a very great, difference of opinion among the witnesses whether the shot, in the present instance, did the work it was intended to do. The manager said it did its work "fairly well," having caused a fall of 7 cwt. The under-manager goes further; he thought "the shot did all the work it was intended to do," but admitted that a close joint would have the effect of weakening it, and may have been sufficient to cause a larger volume of flame outwards. The bailiff agreed that the shot might have done more work, but for the joint; and Bridges, who, as already mentioned, had quite recently fired three shots near to this one, was of the same opinion. Mr. Batey said that it could not be called a blown-out shot, and thought "it did its work." Mr. McMurtrie, general manager of the Radstock Collieries, who also gave evidence on behalf of the owners, said that, "although it was "not a blown-out shot, it did not do the work it should have done; and, even assuming "proper tamping to have been used, it probably gave out a greater body of flame and "of greater length than an ordinary shot." Upon this portion of the evidence I have come to the conclusion, that it is sufficient to indicate that the flame caused by the firing of the shot in question was larger than it would have been, but for the existence, and proximity to the shot-hole, of the close joint.

I have already alluded to the two lumps of oily clay found by the body of Carter. There is no evidence, other than this, that such tamping had in fact been used by him; indeed, both the bailiff and the examiner, who warned Carter about it, thought that a man of his experience would certainly not have used it; as clay, proper for tamping, was obtainable from the fault by the bottom of Peter's Gug, a place equally convenient and near to the shot as that where the oily clay was to be found. This matter is, however, not by any means clear, and if Carter used this oily clay for tamping, it may, in Mr. McMurtrie's opinion, have been a very important factor in causing the exposion, as it would add enormously to the length and fierceness of the flame, containing, as it does, a large amount both of oil and coal-dust. The lump of oily clay found by Carter's body was produced at the inquiry, and Mr. McMurtrie applied a lighted match to a small portion and ignited it. The flame did not burn for more than a few seconds, but the inflammable nature of the material was sufficiently disclosed. I have already stated Mr. Martin's opinion as to the cause of the explosion. Another theory was put forward by Mr. Batey which raises questions of great interest and some complexity.

Inflammable nature of oily clay.

Mr. Batey's opinion.

On the 22nd February Mr. Batey made several tests with Stokes' safety lamp, which will indicate the presence of $\frac{1}{2}$ per cent. of gas. Near the shot hole, at the highest point of the cavity in the roof previously referred to, the lamp exhibited signs of something unusual with the flame; and the same was noticed at a point near the roof of the old road in the Great Vein, which lies 14 yards in-by of the through road. He believes these indications to show traces of carbonic oxide (carbon monoxide) gas, caused in his opinion either by the heating of the gobs on the Great Vein over the large area of old workings there, which have been closed for 36 years, or by the extensive use of gunpowder, several shots having been fired near to the one in question a few days before the explosion. If a small portion of this gas were present, either in the cavity or in the old Great Vein road close by, there would, Mr. Batey thinks, be the means of accounting for the explosion, having regard to the coal dust and debris lodged unseen upon the timbers below the cavity, on the firing of a shot only six yards away.

Carbonic oxide gas.

As already stated the inclination of the shot hole struck the ground immediately below the centre of the cavity; and as, in his opinion, only four to five ounces of powder could have been used in the charge, he thinks it unlikely that the flame from so small a quantity would have fired the coal dust, but that the flash from the shot ignited carbonic oxide gas, and that this, together with the coal dust lodged on the timbers below the cavity, caused the explosion. He considers the accident to have been *unavoidable*, as 4 to 5 per cent. of carbonic oxide gas, in combination with air and coal dust, would form a most explosive mixture, and one very difficult to detect. He added, however, that fire-damp might have been present, and thought the explosion could also be explained on this assumption, but that more probably it was caused both by fire-damp and carbonic oxide gas.

No gas in *upper* series of Radstock coalfield hitherto recorded.

If Mr. Batey's theory is correct, it would have far-reaching consequences in the upper series of seams worked in the Radstock District, as the existence there, either of fire-damp or carbonic oxide gas, has never been recorded or even suspected. Fire-damp was found 20 years ago in the second series, at the Grove Colliery, near

Timsbury; and in the lowest series both these gases have been noticed, Mr. Batey saying that he had occasionally found it present in the upper seams of this series, and frequently in the lower seams. Three witnesses were called on behalf of the owners to prove that gas had been found in the Upper Radstock series. One of them said he had fired it with a naked light at Camerton 20 years ago, in the same vein as one of those worked at Timsbury; two more spoke to the discovery of gas at Hayeswood Colliery, where the same set of seams are worked as at Timsbury. The occasions when this is said to have happened were 42 and over 50 years ago, respectively, when the witnesses were boys of about 13. I am of opinion that the evidence of these three men cannot be relied upon; it seems incredible that no living person should ever have heard of the alleged discovery of gas in this series before the present inquiry, had it really been made, as the subject is one of such constant interest and frequent discussion in the district; and none of the other witnesses called ever heard any suggestion of its having been found there. But, whatever the experience of the past may have been, as to the existence of gas in the upper series, this does not affect the importance of Mr. Batey's evidence. If gas was present on February 6th, as he thinks it was, it is desirable that every possible endeavour should be made to put the matter beyond doubt. With this object he suggests that the owners should block up with masonry the ends of the two old Great Vein roads, where they meet the through road, that have been opened out by the explosion, and that a small pipe should be placed between the cavity and the end of the old road near to it, so that, by examinations of the cavity during the next 12 months, it may be determined whether gas comes from the old workings.

It would have been better, in Mr. Batey's opinion, if, at the time when these old workings were closed, 36 years ago, the roads had been gobbed, and not merely walled in at the ends; but he thinks they may have been left open intentionally, as small coal was not sent to the bank in those days, but remained below; and said that it was a common practice to allow air to pass through the gobs for a few years, after which the decomposition of the iron pyrites in the coal became complete, and the gobs would often close up by the settlement of the superincumbent strata. Both he and Mr. Martin stated that it was customary in this district to leave old workings ungobbed; in non-gaseous mines this is considered safe.

Mr. McMurtrie's opinion.

Mr. McMurtrie thinks Mr. Batey's theory is "more than barely possible," but cannot call it probable. He is rather of opinion that the lengthened flame of the shot, fed by a discharge of dust from the cavity, may have been further extended to Peter's Gug, and have caught and exploded the accumulation of dust there. Mr. McMurtrie said further, that although it has not hitherto been proved that, in the absence of gas, coal dust from the Somersetshire seams will explode by means of gunpowder, (Mr. Hall's experiments, with samples from one of those seams indicating that it will not), yet the dust at Timsbury may have been of such a nature as to produce this result. It thus appears that there is not much difference between Mr. Martin and Mr. McMurtrie as to the cause of the explosion, both attributing it to a direct ignition of coal dust. Mr. Martin thinks there may have been dust in the immediate neighbourhood of the shot hole; Mr. McMurtrie, that there was no dust near the shot, except that lodged on the timbers near the cavity, and he accounts for the explosion by the greater length of the flame being enabled to fire dust at least 18 feet distant from the shot. Mr. Batey gave two reasons for disagreeing with this view; firstly, that Mr. Hall's experiments establish that coal dust from these seams will not ignite directly through firing gunpowder; and secondly, that if it were a coal dust explosion, he could not explain why its course came to an end in places where the mine was very dusty. The latter objection does not seem to me to be very material; the fact that the indications of force ceased in those places is clear, and does not, I think, affect the question what originally caused the explosion, whether a direct or an indirect ignition of dust. Mr. Batey admitted that he was not aware of any explosion in a mine having been directly caused by carbonic oxide gas, and in the whole of his experience, Mr. Martin has only once heard it suggested as a possible cause. There is thus a strong primâ facie case in favour of Mr. Martin's view, and, upon the whole of the evidence, I am inclined to agree with it. But the matter is not free from doubt, having regard to the weight that must necessarily be given to the opinion of Mr. Batey.

Mr. Batey's recommendations.

It is to be hoped that Mr. Batey's recommendations will be adopted by the owners; these are, that gunpowder should no longer be used, but a higher and more flameless explosive, such as roburite, and that in through roads shots should be fired by one man only, specially appointed for the purpose.

The question of negligence.

I am of opinion that the evidence at this inquiry does not disclose or establish that the explosion was occasioned by, and could have been prevented but for, the negligence of any person. It may be that Carter used the oily clay for tamping, and was thus partly responsible for causing an increased length and volume of flame, but I am not satisfied, upon the evidence, that he did; and I think it is clear that there is and can be no suggestion of negligence against any person other than Carter. The place, when the shot was fired, was not dry and dusty; but for the cavity, which was unknown to the present management and was concealed from view by the timbers placed close together underneath, there was no dusty portion nearer than a distance of about 100 yards in-by of the shot, up Peter's Gug; and I do not think that the watering of the mine generally was insufficient. Having considered all the facts, I cannot therefore advise that a prosecution should be instituted against anyone connected with the management or supervision of the mine. But I think that the use of gunpowder in this mine should be prohibited, and that the order exempting the colliery from so much of General Rule 12 as forbids taking an explosive substance into the mine, except in cartridges, should be cancelled. A question of some difficulty arises in this case as to the meaning of the words "dry and dusty" when applied to a mine of which only a portion is in that condition, as the provisions of General Rule 12 subsections (*f.*) (*h.*) and (*i.*) only relate to shot-firing in a dry and dusty "place" in a mine, and prescribe watering, or other treatment equivalent to watering, within a radius of twenty yards thereof and not more; and the word "place" is not otherwise defined by the Act of 1887. In the present instance the "place" was not dry and dusty within the meaning of the Act; but the explosion was, if not caused, certainly intensified, by the presence of dust at much greater distances than 20 yards from the shot. It is submitted that, to insure less risk in the future of the recurrence of a similar disaster, it would be desirable that when portions of a mine are admittedly dry and dusty, every place in the mine should be considered to be so, for the purpose of shot-firing, in order to make it imperative that, in such mines, the precautions prescribed by General Rule 12, above referred to, should be observed in *all* places of firing.

Questions raised in this case.

(Signed) J. ROSKILL.

Temple,
11th March 1895.

List of Witnesses Called at the Adjourned Inquest.

First Day.

Charles Robert Batey, Surveyor.
Frederick Robert Foot, Manager at Timsbury.

Second Day.

John Treasure, Under Manager, Timsbury.
Sidney Lewis, Bailiff, „
George Flower, Examiner, „
George Barnes, Miner, „
Frank Young, Miner, „
Albert Sage, Engineman, „
Charles Bridges, Repairer, „

Second Day.—*continued.*

Farnham Flower, Miner, Timsbury.
John Fear, Labourer, „
Frederick Bull, Miner, „

Third Day.

John Manndrill, Miner, „
George Brice, Under-manager at Kilmersdon Colliery.
Frank Heal, Miner at Camerton Colliery.
John Batey, Mining engineer.
James McMurtrie, Mining engineer.
Joseph Samuel Martin, Inspector of mines.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

Circumstances attending an Explosion which occurred in the Timsbury Colliery, on the 6th February 1895;

BY

JOSEPH S. MARTIN, Esq.,
HER MAJESTY'S INSPECTOR OF MINES.

16, Durdham Park, Bristol,
March 16, 1895.

Sir,

In accordance with your instructions, I have the honour to submit the following special report on the circumstances attending an explosion which occurred on the night of Wednesday, the 6th February, at about or a little before 9 o'clock, in the Timsbury Colliery, near Bath, by which seven persons lost their lives, viz. :—

John Gage, 38, examiner.
John Kieling, 55, examiner.
Joseph Bridges, 51, miner and repairer.
James Carter, 43, miner and repairer.
James E. Durham, 29, miner and repairer.
George Harding, 49, miner and repairer.
George Sperring, 73, miner and repairer.

Dr. Craddock, coroner of the northern division of Somerset, held the inquest at Timsbury before a jury of 15 local residents. Inquest.

There were present, Mr. J. Roskill, Barrister at law, Mr. Bain and myself, representing you; Mr. Metcalf, Barrister at law, instructed by Messrs. Rees-Mogg and Davey, Solicitors, Temple Cloud, representing the Owners and Officials; Mr. Gilmore, Solicitor, Bristol, instructed by Mr. Whitehouse, representing the Somersetshire Miners' Union; and Messrs. Aspinwall and Harvey, representing the National Miners' Federation.

The inquiry, which lasted from 10 a.m. to between 6 and 7 p.m. over three days, was exhaustive, and was conducted to the apparent satisfaction of all those representing the various interests, resulted in an open verdict as follows :—

"That James Carter and the six other men were killed on the night of February 6th last by an explosion caused by a shot fired by James Carter, but the nature of that explosion we are not able to explain. We wish to add that we consider the management free from blame." Verdict of the jury.

"We also recommend that Mr. Batey's suggestion with regard to the use of roburite, or one or the other so-called flameless explosives, should, in future, be used instead of powder."

Description of the Colliery.

The Timsbury Colliery of the present day comprises the workings of Lower Conygre Colliery, commenced upwards of 50 years ago, and of Upper Conygre Colliery,

commenced upwards of 70 years ago, which were formerly worked as separate mines, but, having been communicated underground are now worked, as one. It belongs to a private company or partnership trading under the firm of Samborne, Smith and Company.

Situation of the colliery.

It is situated in the Somersetshire coalfield, about 7 miles south-west from Bath, in the parish of Timsbury. On the south and east it adjoins Camerton Colliery, where, in November, 1893, a parallel explosion occurred with the loss of two lives. On the south and west it adjoins the old Heyswood Colliery, which has been abandoned for upwards of 30 years.

Shafts

There are four shafts, two at Lower Conygre (a down-cast and an up-cast), each 197 fathoms deep and 6 feet 6 inches in diameter, and two at Upper Conygre (a down-cast and an up-cast, each 179 fathoms deep and 5 feet 6 inches in diameter. Coal is wound in the several shafts by a single cage in each. One engine winding from each pair of pits.

The road connecting the Lower and Upper Conygre pits is known as the "through road," one portion of which was driven from the third coal hole at Lower Conygre, 166 fathoms from the surface, the other portion having been driven from the Lower Slyving Vein Coal Hole at Upper Conygre, 171 fathoms from the surface. Allowing for the 20 fathoms difference of level between the shafts at the surface, there is a difference of 15 fathoms between these two parts of this road which are connected by "Peter's Gug," a self-acting incline, about 125 yards in length, driven in the Slyving Vein from the 70 fathom fault-rising at the rate of 1 in 4.

Seams worked.

The seams worked are the same as those now worked at Camerton and formerly worked at Heyswood. They belong to the Radstock or Upper Series of the Somerset Coalfield, viz.:—

The Great Vein, thickness of coal, 26 inches.
The Top Little Vein, thickness of coal, 20 inches.
The Middle Vein (not now worked), thickness of coal, 15 inches.
The Slyving Vein, thicknesss of coal, 20 inches.
The Bottom Little Slyving Vein, thickness of coal, 14 inches.

The coal is of a bituminous character, is moderately hard, and is used for House, Gas, and Manufacturing purposes.

The workings are on the long wall system, gob walls being built on each side of the roadways, and the wastes stowed or not according to circumstances. It is not alleged that the old workings have been systematically stowed close, nor has it been done, apparently.

With the exception of self-acting inclines or gugs, there was no mechanical haulage employed underground. There were eight ponies employed on the main roads.

The "through road" starts from the "Lower Pits" in the Top Little Vein, and at 110 yards (measured on the section) it is continued, in consequence of a 14-fathom fault, in the Great Vein for about 180 yards, to the 70-fathom fault, where it cuts the Slyving Vein, rising as explained at about 1 in 4. At the top of "Peter's Gug" another fault occurs, which again disjoints the steep-lying part of the seams from the almost flat part towards the upper pits.

Referring now to the accompanying plan (instead of the section) the course of the air is shown by arrows.

The accompanying plan prepared for this explosion inquiry only shows that portion of the workings material to the matter under consideration, as to have attempted to show the whole of the extensive workings in the five seams would have rendered it more complicated and confusing than it is already without gaining any advantage. There are marked upon this plan the course of the ventilation (shown by arrows), the positions of the ventilating doors (D), the extent of workings and roadways affected by the explosion (in red), the position of the principal falls (in dark red), the points where the bodies were found (by their names), and in the Top Little Vein workings, and the overlying Great Vein workings the only points in the mine where coked dust was distinctly found.

Ventilation.

The ventilation is effected by a natural current in the shaft, assisted as required by furnace power, and the quantity circulating has been considerably increased within the last two years.

The ventilating current for the Lower Conygre south workings is a distinct split taken from the down-cast to the up-cast at these pits. The effects of the explosion were not felt in those workings, as proved by the two men working there at the time, anp consequently we have no concern with them.

The air travelling from Lower Conygre, along the "through road" to Upper Conygre, is diverted, by double doors at the top of Peter's Gug, through the tunnel to ventilate the Top Little Vein and the overlying Great Vein workings, which are exploited together by inclined roads from the former. It returns back down "Wyatt's Gug" into the "through road" behind the double doors mentioned and continues its way to the Upper Conygre up-cast shaft.

The workings shown on the Great Vein and Slyving Vein, east of the Upper Conygre pits are ventilated by air from the Upper Conygre down-cast, which takes out at the 134 fathom level, and travelling eastward on the "road on Great Vein" to where the doors are marked near the top of "Ozam's incline," branches off through the "workings on Great Vein," returning down "Ozam's incline" behind the doors and outwards along the road on "Top Little Vein" to the bottom of "Branch incline," where it splits. From this point one portion continues along the "level branch," then down "Gullick's Gug" to the "through road," and thus to the up-cast, while the other passing through a regulator ventilates the "workings on Slyving Vein" and returns along the "north branch" to Upper Conygre up-cast.

Another portion of air taking off at the 134 fathom level at Upper Conygre down-cast travels down the "North Dukeway on Great Vein," turning eastward and southward as shown until it meets the "North Branch" just beyond where the effects of the explosion apparently died out, and where the current splits. From this point one portion goes into the "Great Vein workings" while another portion returned along the "North Branch" and ventilates the "Top Little Vein workings" on its way to Upper Conygre up-cast.

Staff and Persons employed.

Management

The owners meet monthly or fortnightly, and take apparently an active interest in the carrying on of the mine, more especially from the economic point of view, receiving reports from and giving directions to Mr. F. R. Foot, the Agent and Certificated Manager. Mr. John Treasure, the holder of a first-class certificate of service, and who for a number of years before Mr. Foot's appointment acted as Certificated Manager, is the Under-Manager, and devotes the whole of his time to the management, going daily underground.

There are three Bailiffs, holders of Under-Managers' certificates of service, who are in the mine throughout the day, and three examiners, who go down about 8 p.m., carrying out and seeing after necessary repairs, and within 2½ hours of the commencement of the morning shift making the examination of the working places in accordance with the Special and General rules.

Persons employed.

About 180 persons are employed underground at this colliery; 170 being in one shift from 5 a.m. to 1 p.m., and the three examiners with from 3 to 10 men, from 8 p.m. to 5 a.m., doing various repairs and any other work which may be necessary, such as leading water, looking after the horses, and examining the places.

Lighting and Firedamp.

Lights used

Naked lights, and naked lights only, have been used since the collieries were first commenced, as well by the examiners going through the workings before the beginning of each shift as also by the colliers and workmen during the shifts. Safety lamps were quite unknown in the experience of the colliery.

Explosive gases.

Firedamp (CH 4), and carbon monoxide (CO.), as well as other explosive gases, have been absolutely unknown in this mine, either as a fact or by rumour, during the 70 years it has been at work, and in no case of testing the ventilation or the cavities in the roof, even with Professor Clowes' Hydrogen flame lamp, which indicates half a per cent. of firedamp, has there been any observed since the explosion. Mr. Batey considers that in the cavity near the shot fired on this occasion he has observed a slight indication (yellow on flame of spirit lamp) of carbon monoxide (CO.), but in this opinion I think he is mistaken. Up to the time of this explosion I had always been given to understand on all sides (including evidence given at the Camerton Colliery Explosion Inquest in November 1893), that firedamp was entirely unknown and unrecorded, even by rumour, as having ever been met with in any of the several seams forming the Radstock or Upper Series of the Somersetshire coalfield, which is that worked at this colliery. Upon such representations in 1888, when Special Rules were being prepared for the collieries in this coalfield, the Secretary of State acceded to the desire of the owners and their representatives that there should be no rules of any kind referring to or hinting at the words "firedamp" or "safety lamp" embodied in the

code of Special Rules for the collieries working this or even the "Farrington or Second Series," lying about 100 fathoms below.

Alleged ignition of firedamp at Camerton Colliery 20 years ago, in the Radstock or Upper Series.

At this inquiry, however, there were three witnesses called to prove that they recollected having seen *firedamp ignited* in these seams, viz. :—One (Frederick Bull) a coal miner, 48 years of age, described the most recent alleged case and stated that on one occasion about 20 years ago, he ignited "firedamp" at his own candle in Camerton Colliery. He explained that having fired a shot in the same Great Vein as worked at Timsbury, he returned and placed his candle near a crack at the back of the lump of coal, when gas ignited and flame, or "a light" as he described it, ran up two or three yards along the roof; it was very little, and burned neither himself nor his comrades, of whom there were three in the same working face. He said that it was on the deep side that this occurred, and that his three comrades also saw the flame. One of the comrades referred to (Frank Heal) was called, and denied that he had ever seen gas fired at Camerton, but stated that he recollected once, about 20 years ago, that after Bull had fired a shot in a place as described on the deep side, he (Bull) went back with his candle and afterwards told them that when he put his candle to the crack behind the lump of coal, a light came out, but he (Heal) never saw it, although at the same coal face, and within 10 yards of him. Both said it was not reported to any of the officials.

Probable explanation of alleged gas at Camerton.

That it was firedamp Bull ignited is highly improbable, as no other instance is known by rumour even. There can be little doubt, and there is absolutely none in my mind, that Bull, having returned very soon after the shot went off, upon putting his candle to a crack in the coal face behind the lump of coal (which would tend to screen the crack from even the, at that time, very limited quantity of ventilation circulating), ignited a small quantity of gas resulting from combustion of the powder itself, and that it was not firedamp he ignited. He had been working at collieries near Bristol and in Monmouthshire, where he had seen some small quantities of firedamp ignited, and he not unnaturally thought this must be the same.

Alleged ignitions of firedamp at the Old Heywood Colliery 43 to 53 years ago, in the "Radstock or Upper Series."

Having, I think, satisfactorily disposed of that alleged instance of "firedamp" having been seen in the Radstock or Upper Series of the Somersetshire coalfield, we have to travel back another 23 to 33 years, or a period of 43 to 53 years from the present time, for the next instance in which there is any allegation of the kind. In proof of these instances of the presence of "firedamp" there were called :—A collier (John Mandeville), who stated his age to be 55, and that he had worked all his working life in this (Timsbury) and adjoining collieries. He first commenced work underground 42 years ago at (the old abandoned) Heyswood Colliery, as a filler for the branchers (one of whom was named Job Cox). Soon afterwards, upon going into the branch one morning there was a sudden flash of light, and in reply to his inquiry as to what it was, Cox told him that he had lighted the "foul air." A lad named Knight was also with them, and their shirts and hair were singed by the flash. The Under-Manager of Kilmersdon Colliery (George Brice) was also called to speak to "firedamp" having been met with at Heyswood Colliery; he stated his age to be 65 and that he commenced work at (the old abandoned) Heyswood Colliery adjoining this (Timsbury) Colliery when he was 12 years of age, and that he recollects seeing "firedamp" or gas ignited the first year he was there. "The lads used to light it at a hole in the roof which was drilled three or four inches deep, for a plug from which to suspend the surveyor's line for driving the road in its proper course." The plug had fallen out and the gas issued from the hole. He alleged that he knew of its being lighted on a Saturday and being still burning on the Monday morning.

Explanation of alleged gas at Heyswood not attempted.

I do not pretend to explain away these alleged facts, and I do not think they require it, the history is too ancient to deal with, but if they are correct I can only congratulate both these men upon their memories for details, and express surprise under the circumstances that the facts were not more generally known, even as rumour, in the district, as well as at the apparently otherwise absolute absence, even of indications of "firedamp" in the whole series of eight seams throughout the whole of the coalfield.

"One swallow does not denote summer," and "exceptions prove rules," so that I think if the alleged facts are even admitted, or at least not contradicted, we may still consider the Radstock or Upper Series of seams absolutely free from firedamp until we have some further and more recent proof to the contrary.

I do not think it is necessary, with reference to this accident, to pursue the matter of the presence of gas in these seams further, and I think we can totally disregard the question, as, although it has been brought forward with a view of raising a point and showing a possibility, a very "bare possibility" of its existence, it does not appear that "firedamp" really did play any part in this explosion.

Coal Dust and Watering.

Liability of coal to cause dust.

Although the coal is moderately hard, especially when compared with the Ashton and Bedminster Great Veins, or with South Wales steam coals, and consequently does not disintegrate so readily, it still in a greater or lesser degree deposits dust on the roadways in transit to the shafts.

Condition of mine as to dust.

I was aware before the explosion that parts of the mine were dry, and that more or less dust existed in parts, but it had not occurred to me that the mine generally was one which would come within the category of a "dry and dusty mine." This, of course, is a question of degree and opinion, and its not having appeared to me as such may be due to lack of passing observation, my attention being fixed upon some other matter, or in consequence of the roadways having been watered.

Dry and dusty.

Judged after the explosion, there is no doubt as to its being a "dry and dusty mine." From what I have since seen of the effect of a comparatively small quantity of water on the roadways in this mine it is quite open for an Inspector or any stranger making an occasional inspection, at times not to notice, or to be mistaken in the true character of a mine in this respect, and *it clearly shows how impracticable and dangerous it would be to attempt to remove from the authorities at the respective collieries and to place upon the Inspectors of Mines any initiative responsibility as to whether certain precautions were necessary or not.*

Initiative responsibility as to nature of mine.

Watering.

From the evidence it appears that a certain amount of watering was carried out, and that the "through road" between the 70 fathom fault and the Lower Conygre pits had been watered three or four days before the date of this accident. The under-manager (John Treasure) and the bailiff (Sidney Lewis) stated that on the day of the accident they passed along the road between the 70 fathom fault and Lower Conygre pits, and that they noticed its condition, more especially in the vicinity of where they subsequently ordered Carter to fire a shot in the roof at the point marked on the plan, and that they considered it so damp and free from dust as to be fit for blasting. I do not agree with this latter opinion, and, judging by the condition of the road when I saw it about 15 hours after the explosion, I feel satisfied, that there was and must have been dust on the sides and roof of the road at least, if not on the floor, and that they have formed an erroneous, although probably bonâ fide, opinion upon its condition.

Under Manager and Bailiff's opinion as to condition of road on day of explosion.

Blasting.

Powder as explosive largely used.

Powder has been the explosive exclusively used at this mine during its existence and it has been largely used in the headings for ripping top and blowing up floor in order to make height for the roadways, the seams all being thin. Mr. Samuel Raine, of Midsomer Norton, has recently supplied the powder, the Elterwater Company (trade mark E.W.) being the makers, and I understand the same powder was in use at Camerton Colliery when the explosion occurred there, having been previously supplied by Messrs. Harvey and Curtis, Shirehampton. Squibs, motes or straws, and fuze have been used for firing the shots, and all qualified colliers have been appointed or looked upon as Competent Persons to fire shots. Previous to the explosion at Camerton Colliery in November 1893, no special precautions at all appear to have been thought necessary, and blasting was allowed anywhere and under every condition; but, from the evidence, it appears that since that time various precautions and restrictions have been introduced, and blasting upon main roads has been much reduced. Mr. E. E. V. Stokes, having on the 28th September last made inspection and inquiry at the mine, reported to me at the time that blasting was carried on at the end of the shift by persons appointed. That it was not allowed on the "gugs" or the main roads as a rule, but that whenever it was resorted to, the place was thoroughly watered, if it was at all dusty and that the "gugs" which were dusty were regularly cleaned down and watered once or twice a month as they appeared to require it.

Result of assistant inspector's inspection four months before.

Local Manager's views as to dust, and Mr. Hall's experiments.

It has been strongly held by Managers in this coalfield—and in support of this view Mr. Hall's experiments have been quoted—that whatever might be the effect or cause of explosions in other districts, the experience of a century in the Somersetshire coal-field, with the use of large quantities of powder, used under all circumstances and conditions of the roads (but in the total absence of firedamp in the seams), explosions of such dust as is met with in the mines of the Somersetshire coalfield, working the Upper and Second Series of seams is inconceivable.

First disturbing experience.

The first disturbing experience to this view occurred at Ludlow's Colliery, on the 24th November 1891, and it is an extraordinary thing that after such a long previous immunity throughout the coalfield from anything of the kind, there should within $3\frac{1}{2}$ years have followed two such absolutely clear cases as those at Camerton in November 1893 and this one.

They have at least overcome my strong opposition to the theory and satisfied me that the "dust theory" is well based, and that the chain of experiments carried out in the earlier days in small wooden pipes, and gradually extended on a larger scale, have demonstrated exactly what has resulted in these three cases in actual working experience.

The Explosion.

Notice of explosion having occurred and rescue explorations.

It was first noticed that something unusual had occurred in the mine by the engineman and bailiff at the Upper Conygre pits about nine or a quarter before nine o'clock in the evening. They were at the time in the candle house, not far from the top of the pit, when they heard a noise down the pit as well as a rattle in the winding-engine gearing. They subsequently noticed smoke coming up the shaft and without loss of time the engineman reported the matter to Mr. John Treasure (under manager), and by his direction also to Sidney Lewis, the Lower Conygre bailiff, and then returned to the pit, where, upon examination, the winding engine, which works on second motion, was found to be disabled, some of the teeth of the cog-wheels having been broken, apparently by the cage having been blown up some distance in the shaft, and in falling back suddenly it caused a jerk which broke three teeth. The Under-Manager and Bailiff with others proceeded direct to Lower Conygre, and descended the shaft to the level of the through road. At the mouthing there they found the examiner Flowers and his comrade Fear, who informed them that an explosion had occurred. Upon proceeding along the "through road" beyond the ventilation doors near the pit (which were uninjured), they met with some falls in the road, and reached the point where James Carter had been ordered to fire a shot in the roof and which had been done. Proceeding further to the bottom of "Peter's Gug" at the 70 fathom fault, they found the body of James Carter in a manhole severely burned. The Manager and additional assistance having arrived, further explorations revealed heavy falls and indications of greater force up the incline and in the workings. The bodies of Bridge, Durham, Gage and Harding, were found severely burned in the "workings on Top Little Vein" up Parfitt's Road, as marked on the plan, and some hours later those of Kieling and Sperring were found near the Upper Conygre pit also badly burned, as were the four horses in the stables close at hand, which were also killed.

Location and Extent of Explosion.

Origin of explosion.

It is unanimously agreed that the origin of the explosion was the shot in the "through road," fired by Carter, in accordance with instructions from the Bailiff, at a point about 80 yards from where his body was found.

This shot was in the roof of the "through road" for the purpose of increasing the height of the roadway, in order to allow of a pony working along it. The hole had been drilled several years ago and allowed to stand unused. It was a $1\frac{1}{4}$ inch hole, drilled 13 inches deep, and had a thickness of roof to blow down at the end of the hole of about a foot. It evidently was expected to rip the roof down for some feet in advance of the end of the hole, but just as in the Camerton case, a close unnoticeable joint ran across about 2 inches beyond the end of the hole, entirely cutting off its work. There was considerably less than a tram of rubbish thrown down, whereas it should have brought two or three had it not been for the joint.

Direction of force.

The force outwards against the air was, apparently, only slight. The doors at the bottom of the shafts, 300 yards distant, not having been disturbed, the only damage was at a point about 100 yards from the shot, where a portion of the side wall was blown into the road. In the direction of the air current, force and flame appear to have increased between the shot and "Peter's Gug," and then extended through the "workings on Top Little Vein" the "workings on Great Vein," overlying them, along the "through road" to the Upper Pits, and a distance of about 660 yards beyond them on the north branch, where the indications became no longer noticeable. From the "through road" the indications also extend up "Gullick's Gug" and along the road towards "Ozam's Incline" for a distance of about 180 yards, and from the north branch into the "workings on the Slyving Vein" and "Top Little Vein," as shown on the plan.

The incline drum, at the top of "Peter's Gug," was moved towards the upper pits, the double doors just beyond and the trams standing in the siding were blown about 20 yards along the road; the doors in "Parfitt's Road" were blown upwards from "Wyatt's Incline," the doors in the different roads leading from Parfitt's Road were all blown

inwards or away from it, in each case for distances of from 15 to 30 yards. In the same way doors in the roads out of the "north branch" and the road leading from "Gullick's Gug to Ozam's Gug" were blown inwards.

Indications of fire.

The indications of flame were few, practically only observable on the bodies of the men, all of whom were burned, and the three places where coked dust was found, namely, in the "workings on Top Little Vein," as marked on the plan in the road leading to "Barnes Road," near the top end of Parfitt's Road, where marked "1,000 yards from pit," and on the end of a tram in the "workings on Great Vein" up "Parnell's Incline."

Location of falls.

The principal falls occurred in "Peter's Incline," on the "through road," as far as "Gullick's Gug," in "Wyatt's Incline" and "Parnell's Incline," the remainder of the workings being comparatively uninjured.

Cause of Explosion.

Mr. Batey's opinion.

Mr. John Batey, Mining Engineer, of Coleford, near Bath, who has had a long and large experience in this coalfield, and who was called as an expert by the colliery proprietors, gave it as his opinion that the explosion was caused in the first place by a shot in the roof of the "through road," which was fired by the deceased, Carter, in accordance with orders from the bailiff (Sydney Lewis), and which he considered did its work fully.

That the shot communicated flame into a cavity which existed in the roof of this road about 6 yards inwards and there ignited inflammable gas.

That the inflammable gas may have been firedamp (CH_4), or carbon monoxide (CO), or both mixed.

That one or other, or both of these gases may have existed in the old Great Vein workings on the lower or left-hand side, which have been standing for 36 years, and that they may have insidiously crept up into this cavity along a slight gutter in the roof on the lower side, from an old road which existed 6 feet on the inbye side, and which was only disclosed by the explosion, the mouth of it having been bashed up. The existence of this road, it was alleged, was unknown to any of the present officials.

That carbon monoxide (CO) may have collected there from the products of combustion of powder, which was used a few days before in blasting roof on the road, some 20 yards or so on the inbye side.

Mr. Batey considers he saw on the flame of a Stokes' spirit lamp indications of carbon monoxide (CO), and also that on the 22nd March, or 16 days after the explosion, when my colleagues, Messrs. W. N. Atkinson, A. H. Stokes, and Robson, made inspection, that a yellow flame, which was at times noticeable, was due to carbon monoxide (CO), whereas neither Messrs. Atkinson, Stokes, nor I agreed with him on the point, it being, in our opinion, due to dust in the air disturbed by our movements.

In support of his expressed views he referred to the fact of "firedamp" having been found in this series of seams, according to the witnesses previously referred to (*see* Lighting and Firedamp, page 6), also that he has, he believes, known of carbon monoxide (CO) having occurred in this series, through the heating of gobs, and certainly in another series in the coalfield. He was, however, unable to say that he had ever before known of a colliery explosion attributed to carbon monoxide.

Mr. McMurtrie's opinion.

Mr. James McMurtrie, Mining Engineer, of Radstock, who has also had a long and large experience in this coalfield, and who was called as an expert by the colliery proprietors, considered that Mr. Batey's view as to inflammable gases, while perhaps "more than a bare possibility," was improbable. He thought that the shot, which had not done its work owing to the close joint, and was consequently overcharged, gave off a considerable flame, which, striking the floor, rebounded into the cavity referred to, and there distributed dust accumulated up in it, and unknown, or even thought of, upon the timbers, and that thus sufficient explosive power was obtained to carry the flame forward, on the road to pick up and ignite dust from the sides, until it reached "Peter's Gug," which was admittedly "dry and dusty." He considers that if the shot had been stemmed with material (oil and dust), a lump of which some of the witnesses deposed to having found near Carter's body, and which they thought looked as it prepared for the purpose, it would in all probability have very materially increased the flame, it being of a most inflammable character, as he indicated by applying a match to a small portion, when it burned freely.

J. S. Martin's opinion.

For my own part I have no hesitation in fixing upon dust, ignited by the overcharged shot described, as the source of the whole damage. It is well known that a shot which is overcharged through any cause gives off flame, the amount of which varies

J. S. Martin's opinion.

according to circumstances. In this case the cause of the overcharge was brought about as in the Camerton case, from an apparently proper charge by an unseen joint reducing its effective work.

We have it in evidence from the Under-Manager, Bailiff and Workmen, that the road some days before the explosion was dry and dusty, and that it was subsequently watered. The means adopted as described were not, however, such as would lend itself to my mind, in practice, as being capable of thoroughly damping the sides, namely, splashing water with their hands from buckets, nor was the quantity of water used with buckets such as would, in my opinion, absolutely prevent the presence of more or less dust on the rough sides, &c., although the floor might, as stated, have been actually wet. A current of dry air—hygrometic readings indicated four to six degrees of dryness—passing along the road at a speed of 6 feet per second for three or four days, without any corresponding counter effects, would have a very drying tendency. Judging from my inspection of the place, about 15 hours subsequent to the explosion, I consider that there must have been and was some dust present at least on the sides of the road, as well as on the timbers and in the cavity referred to. Probably there was some on the floor, mixed, very probably, with some of the powder spilled in the process of charging the hole, which would naturally assist the initiation of the explosion.

The evidence of the Under-Manager and Bailiff shows that from their examination of the place on the day of the accident, it was not, in their opinion, "dry or dusty"; this of course is a matter of degree and is a question of opinion, which is a weak point about it, but I consider, judging by results and appearances when I saw the place, that they committed an error of judgment, which is all the more likely and to be readily understood if we bear in mind their own experience and that it was a generally accepted fact, and unfortunately is so still among the men in the coalfield, that even if it were perfectly "dry and dusty" there would be no danger.

Probably if it had not been for that unfortunate and unseen joint, this explosion would not have occurred.

It will be seen that, in my opinion, I am very largely, if not altogether, corroborated by Mr. McMurtrie.

I do not and cannot agree with Mr. Batey's views as to the probability of explosive gases in the cavity having had anything whatever to do with the explosion. I am unable to see, even from subsequent inspection, how the gases, if even present in the old workings, could have worked back to the cavity along the gutter referred to, bearing in mind the fact that a good current of air travelled along the road in the opposite direction.

I am equally unable to accept the possibility of the gases having been pent up in the old workings, as suggested by Mr. Batey; as judged by the quantity of rubbish which was blown into the "through road," certainly *not more* than three or four feet of the end of the old road could have been filled up. There was no masonry in front of it which would tend to make it air-tight, and this quantity of dry rubbish would certainly not have rendered it air-tight, considering the pressure of air which has since been tending to circulate through this old road.

I am also unable to accept the accuracy of the witnesses as to firedamp ignitions when they were 12 years of age, 43 and 53 years ago. While quite willing to consider that their statements are made honestly and in the belief that it was firedamp, I feel no doubt that if the full circumstances were known the events would bear another explanation.

Bearing in mind the experience of the mine for 70 years and the result of subsequent inspections and examinations, to explain this explosion as having had any connexion with the ignition of an accumulation of firedamp or of carbon monoxide in the cavity, as suggested, necessitates surmises of so many *perhaps not* absolutely (I think myself even absolutely) impossible coincidents, that I cannot for a moment place them in the balance with what is experimentally known as a common occurrence with coal dust, and which has been practically demonstrated at Ludlows and Camerton Collieries. Slow as I have been in the past to accept dust as an agency for explosions without explosive gas, I repeat that I have no more hesitation in this case than I had at Camerton in attributing the explosion to dust having been ignited by the shot in the "through road" without any assistance from inflammable gas.

It is at present impossible to say with accuracy how or why the force of the explosion did not extend beyond the point at which it ceased in the road leading from the top of "Gullick's Gug" towards Ozam's Incline, where dust apparently existed, although I am informed by the Under-Manager that the haulier frequently had the tank sent up there and watered the road regularly for his own comfort. On the

"North Branch" it may be said that the dust ceased to be coal-dust, as for six or eight months past there has been practically no coal (not more than about 30 tons) transported over this part, while for some months rubbish from a "cut" or stone drift was conveyed over it.

It may be pointed out that the explosion appears to have travelled only short distances comparatively against the air where the current was travelling with any considerable force or speed.

I think it right towards the deceased man Carter to say that although I think he may possibly have stemmed the hole with dust from the road, which he would probably not consider coal dust, I do not think it at all probable that he would use such material (oil and dust) as that which was found near him in the refuge hole after the explosion. Either he or any other person with ordinary or even moderate sense would know that it was not suitable for this purpose, and there is nothing to show that he was a man who would be likely to use it wilfully in preference to more suitable material which was to be had at or close to the same place.

Contravention of the Act.

Except that the result, in my opinion, proves that the requirement of General Rule XII., Subsection (*f.*), was not and cannot have been complied with to the full extent of the wording, I am unable to find that any contravention of the Coal Mines Regulation Act, 1887, or of the Special Rules established for this mine in accordance therewith has occurred, and I am of opinion, in view of the evidence at the coroner's inquiry, that no proceedings could be sustained. I do, however, consider that, viewing the cause of the explosion as I have already explained, there has been an unfortunate and serious error of judgment on the parts of the Manager and Bailiff with regard to the condition of the road.

I think I cannot do better than here repeat the concluding precautionary suggestions of Messrs. Robson, Hall and myself, in our joint report on the Albion Colliery explosion with reference to shot firing, which are proved in this as well as the Camerton explosion to be applicable to non-fiery as well as fiery mines.

"We take the opportunity of impressing on Owners and Managers of mines the urgent necessity that exists for dispensing with the use of explosives as far as possible, and that where used only the safest that can be obtained should be allowed or used."

"We also recommend that all shots should be properly tamped with clay and fired by electricity; and that blasting should only be carried on while not more than 10 persons are in the mine."

"It does not appear that gunpowder was used in the Albion Colliery. It is, however, largely used in many collieries in South Wales and in some other districts, even where the mines are fiery and worked with safety lamps, as well as 'being dry and dusty.' We think that blasting with gunpowder and other flaming explosives should be abolished altogether in the working of such mines."

"With regard to dealing with coal dust in mines, we are of opinion that all main roads should be systematically watered, and that the dust thus damped should be frequently removed from the roads and sent out of the mine."

I go further, and I beg to confirm my evidence before the Royal Commission on Coal Dust Explosions, and I would abolish the use of powder entirely in mines.

I have, &c.,

JOSEPH S. MARTIN,

H.M. Inspector of Mines for the South Western District.

TIMSBURY COLLIERIES.

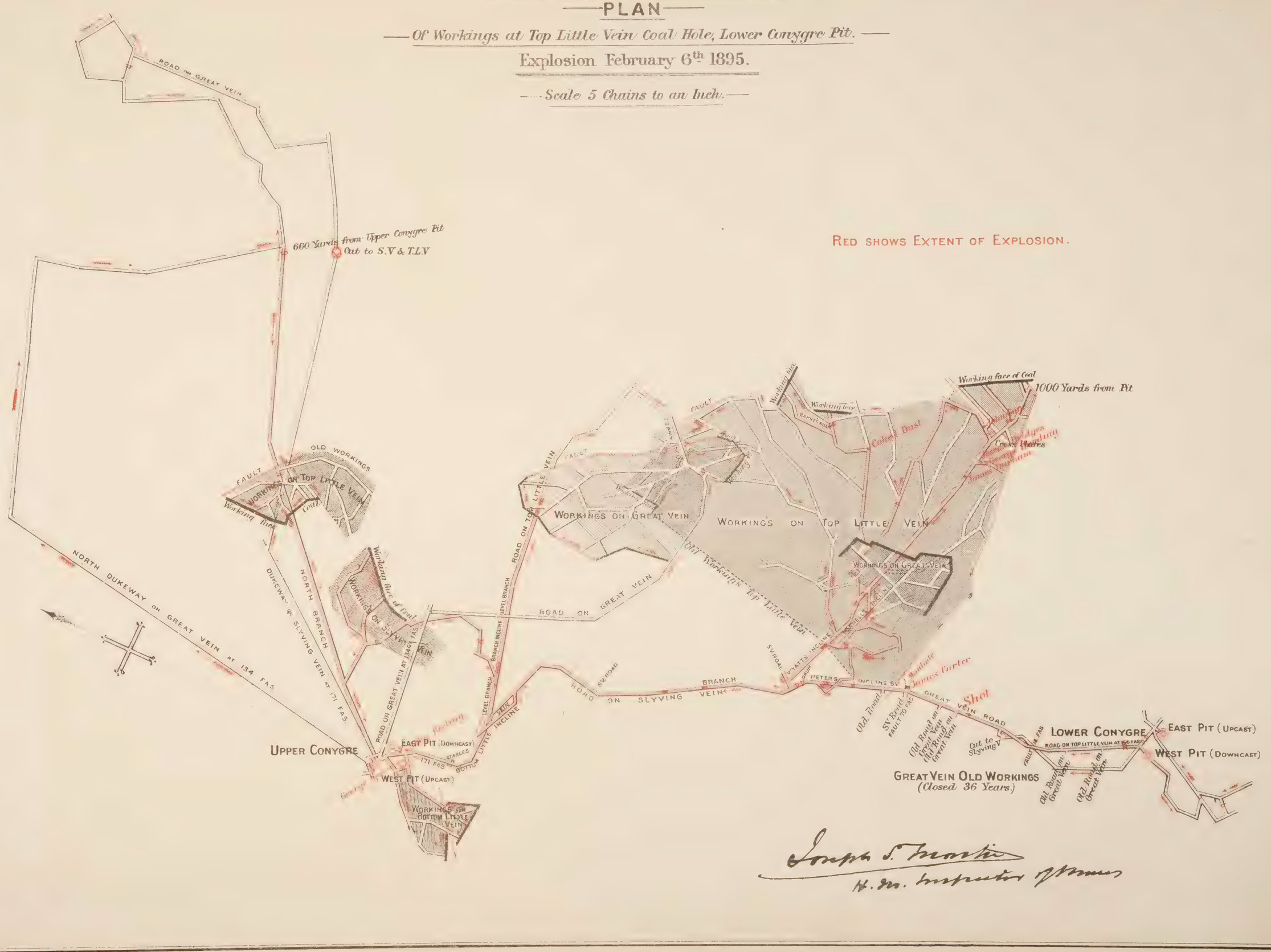
PLAN

Of Workings at Top Little Vein Coal Hole, Lower Conygre Pit.

Explosion February 6th 1895.

Scale 5 Chains to an Inch.

RED SHOWS EXTENT OF EXPLOSION.



Joseph S. Moxon
H.M. Inspector of Mines

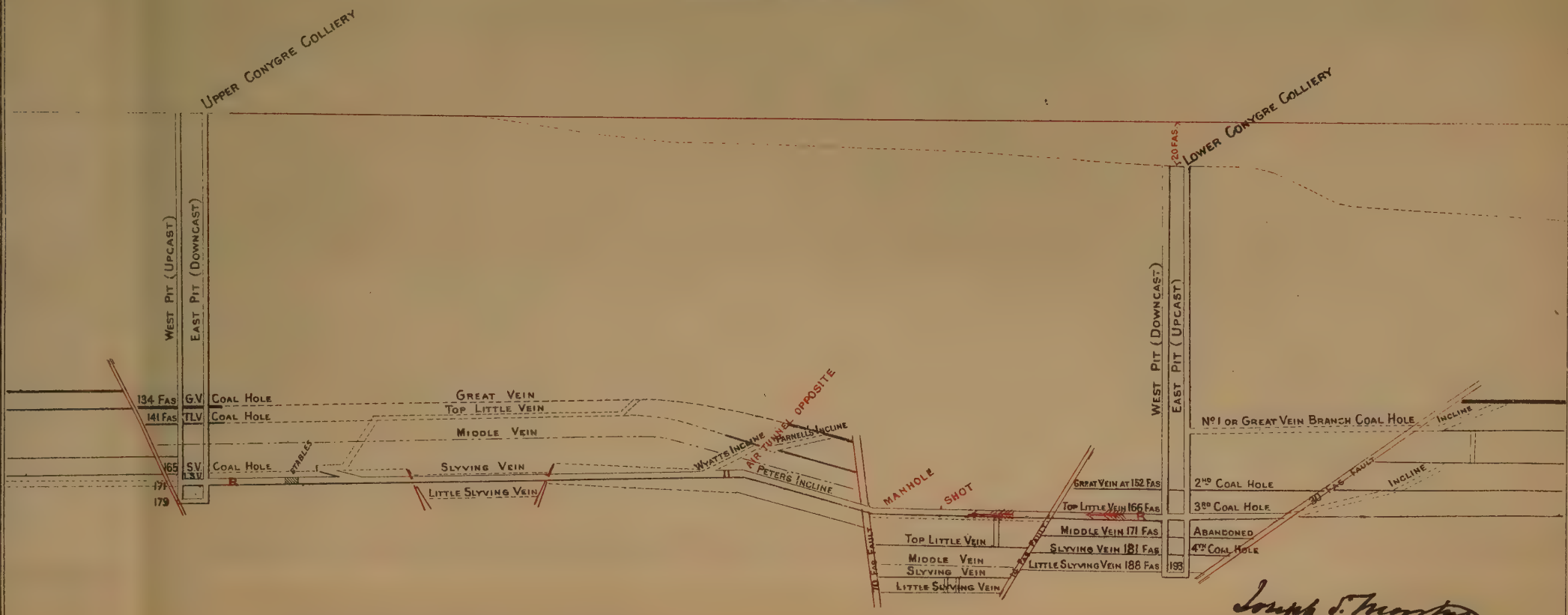
Wyman & Sons, Lt.d, Lith 7294-5-95.

TIMSBURY COLLIERIES.

—SECTION OF SEAMS.—

—On Line of Underground Road between Upper & Lower Conygre Pits.—

February 6th 1895.

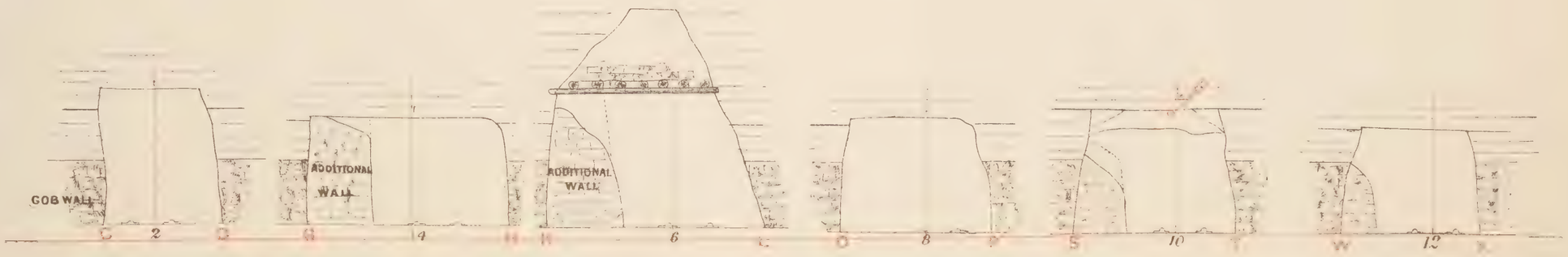


Horizontal Scale 6 Chains to an Inch.
Vertical Scale 60 Fathoms to an Inch.

Joseph S. Thomas
H. M. Inspector of Mines

Wyman & Sons, Ltd. Lith

CROSS SECTIONS.



TIMSBURY COLLIERIES

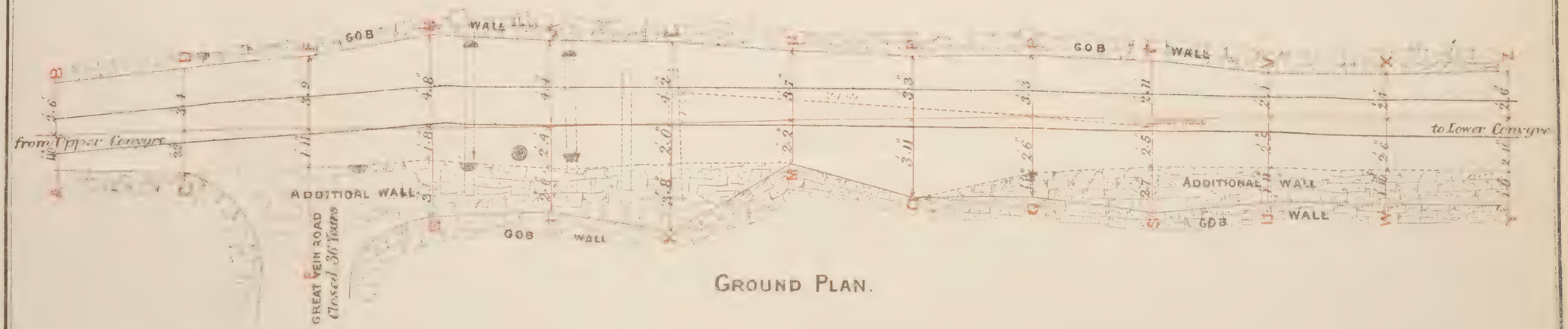
PLAN AND SECTIONS

Of Road near Shot Hole between Upper & Lower Conygre Pits.

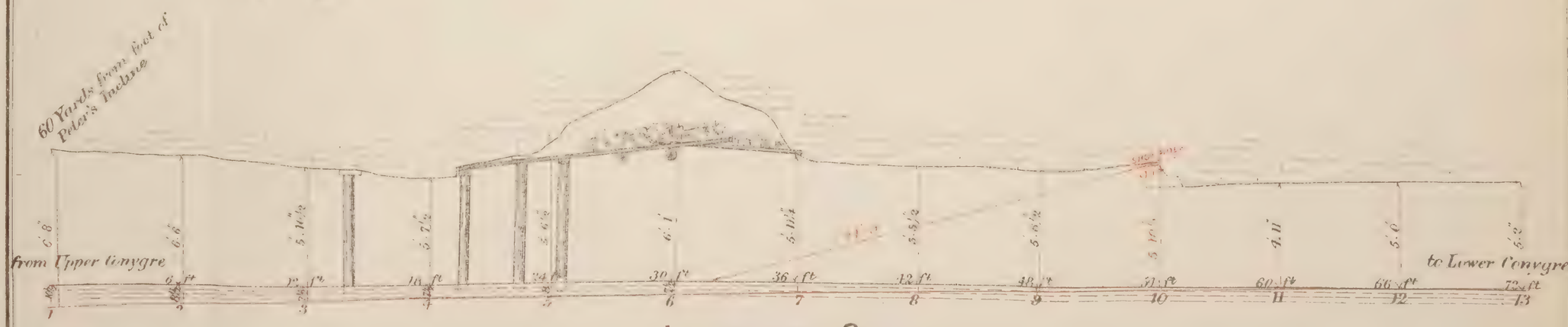
Scale 6 Feet to an Inch

February 6th 1895

Joseph F. Thornton
H. M. Inspector of Mines



GROUND PLAN.



LONGITUDINAL SECTION.

No. CXII.

REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

CIRCUMSTANCES ATTENDING AN IGNITION OF CANNONITE

WHICH OCCURRED IN THE

GRANULATING HOUSE OF THE FACTORY OF THE WAR AND SPORTING SMOKELESS POWDER SYNDICATE, LIMITED, AT TRIMLEY MARSH, SUFFOLK,

On the 12th March 1895 ;

BY

COLONEL A. FORD,

H.M. INSPECTOR OF EXPLOSIVES.

Presented to both Houses of Parliament by Command of Her Majesty.

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REPORT

TO

THE RIGHT HONOURABLE THE SECRETARY OF STATE FOR THE HOME DEPARTMENT

ON THE

Circumstances attending an Ignition of Cannonite, which occurred in the Granulating House of the Factory of the War and Sporting Smokeless Powder Syndicate, Limited, at Trimley Marsh, Suffolk, on the 12th March 1895;

BY

COLONEL A. FORD,

H.M. INSPECTOR OF EXPLOSIVES.

SIR, Home Office, April 15th, 1895.

I HAVE the honour to report that in obedience to your Order of the 20th March,* made under the 66th section of the Explosives Act, 1875, I have held an Inquiry into the circumstances attending the ignition of cannonite which occurred in the granulating house of the Factory of the War and Sporting Smokeless Powder Syndicate, Limited, at Trimley March, Suffolk, on the 12th March 1895. Fortunately no one was killed by this accident, and only one man was injured.

Trimley factory.

The factory at which the accident happened is situated at Trimley, about 3½ miles from Felixstowe. It was established in virtue of License No. 94, dated the 3rd March 1892, and has thus been in existence about three years only. Two amending licenses have since been granted for the factory. The explosives authorised to be manufactured at the factory are cannonite No. 1, cannonite No. 2, and cartridges for small arms.† Mr. Herbert Manning Chapman is the manager.

The granulating house.

The granulating house in which the accident occurred is marked F¹ on the plan of the factory, cannonite No. 1 having been in course of manufacture at the time. The operations allowed to be carried on in the building are thus stated in the license :—‡

Distinguishing number, letter, or name of building, room, or place on plan attached to License.	Application of building, room, or place, or process to be carried on therein.	Explosive allowed or ingredients or articles liable to spontaneous ignition or inflammable, or otherwise dangerous, and limitation of quantity to be in each building, room, or place.	Limitation of number of workpeople to be in each building, room, or place.
F¹	(*a*) Cutting and granulating cannonite.	(*a*) Cannonite, 250 lbs.	(*a*) 2.
	Or, *in lieu :*		
	(*b*) Sifting cannonite	(*b*) Cannonite, 250 lbs.	(*b*) 2.
	Or, *in lieu :*		
	(*c*) Drying guncotton, and depositing the same for use in the factory.	(*c*) Guncotton, 250 lbs.	(*c*) 2.
	Or, *in lieu :*		
	(*d*) Expense magazine	(*d*) Cannonite, 250 lbs.	(*d*) 2.

Provided that the operations (*a.*), (*b.*), (*c.*), (*d.*), shall not be carried on in the building at the same time.

* Home Office Papers, X 31967.

† Cannonite No. 1 and cannonite No. 2 are defined as follows :—

Cannonite No. 1, consisting of guncotton (consisting of thoroughly purified nitro-cellulose) mixed or impregnated with a nitrate or nitrates (other than nitrate of lead or nitrate of ammonium) and rosin, and with or without the addition of graphite.

Cannonite No. 2, consisting of guncotton (consisting of thoroughly purified nitro-cellulose) mixed or impregnated with rosin, and with or without the addition of graphite.

‡ As modified by amending license, No. 650, dated the 28th September 1894.

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At the time of the accident operation (*a*) was being carried on, the amount of explosive in the building, so far as I have been able to ascertain, being only about 50 lbs., and there was one work-person present.

The process of granulating cannonite is very similar to that in use in the manufacture of gunpowder; but the cannonite reaches the building, not like gunpowder, as hard slabs or "press-cake," but in the form of long threads, not unlike coarse horsehair, it being thus formed by means of a "squirting" machine in another building. While, therefore, in the case of gunpowder, the press-cake is broken up into grains of the required sizes, the cannonite thread is merely broken into pieces of the required lengths, by granulation.

The building F^1 is rectangular, of galvanized corrugated iron, lined throughout with wood, about 15 feet by 12 feet externally. In one corner there is a small compartment, about 4 ft. 6 ins. by 3 ft. 6 ins., divided off by a wooden partition, and containing a small engine for driving the machinery; the remaining space is occupied by two granulating machines. One, the smaller of these, consists of a revolving disintegrator, in which the threads are first broken into short lengths, with one pair of fluted rollers, between which the short lengths are further broken into pieces, below the disintegrator. The disintegrator and rollers are made of phosphor bronze. A tray below the rollers receives the pieces, which are transferred by hand to a sieve, worked by an eccentric below the larger machine. Any portion of the thread not sufficiently broken up in the smaller machine to pass through the sieve is carried by small buckets, attached by an endless band, to the top of the larger machine, and there falls into another disintegrator, whence it passes between three pairs of fluted rollers, and again into the sieve at the bottom.

Circumstances of explosion.

William Bown, the only workman employed in F^1, had been engaged the whole of the morning of the 12th March (the day of the accident) in cleaning the machines and the building. After the dinner hour (12 to 1) he returned to the building, and about 50 lbs. of cannonite thread to be granulated reached it directly afterwards. This was brought to the building from the drying-house in a galvanized-iron bin with a wooden cover by another workman, who put the bin on the floor and then went away. Bown transferred the thread from the bin in small quantities to a tray placed on a stool near the smaller machine, which he fed as required from the tray with a copper scoop; and when about half of the thread had passed through that machine, he commenced to remove portions from the tray below it to the sieve under the larger machine with the same scoop. Both machines were now in work; and Bown, standing between them, had just fed the last portion of the thread into the smaller machine when—to use his own words—he fancied he saw a kind of flicker—something like a star—shoot down the right-hand side of the machine, and he was at once involved in flames. He scrambled for the door, and, kicking the footboard, fell up against the door post, but ultimately got out, not, however, without being very badly burnt about the head and hands. The uninflammable clothing, which is required by the terms of the license to be worn by all persons employed in danger buildings, was most effective in protecting the other parts of his body.

The damage to the building was of a trifling character, the woodwork being more or less charred by the flash, but not set on fire. Of the eight panes of glass in the window only one was broken, the remaining seven being merely cracked.

Cause of explosion.

An examination of the fluted rollers of the smaller machine, when it was taken to pieces, showed that they had been scored by hard substances passing between them, one of the marks of the scoring being quite bright, and evidently made quite recently: and in view of the fact, first, that Bown had just put into the machine the *last* portion of the thread, in which a foreign substance, such as grit, would, if at all, most probably be contained; secondly, that the temperature which must have been attained by the scoring was far in excess of that required to cause the ignition of the cannonite (viz. 360° Fah.); and, thirdly, that Bown actually observed the ignition in the smaller machine, I think that there can be no reasonable doubt that the presence of some foreign substance in that machine was the cause of the mischief. No other explanation of the occurrence presented itself in the course of my Inquiry. A sample of the explosive received from the manager, as similar to that which was in the building at the time, has been examined by Dr. Dupré and proved to be correct in all respects. The report of the chemical examination will be found in Appendix A.

It was suggested to me by a member of the firm that the scoring on the rollers might have been caused by harder portions of the explosive, "knots," so to speak, in the thread; but I think that there can be no doubt that if explosive had been

subjected to the force necessary to produce scoring on the rollers it must have been set on fire or exploded on previous occasions. It is, moreover, far more reasonable to suppose that the metal rollers would crush up "knots" of a gelatinous substance, however hard, than that they themselves should be scored by the knots.

As to blame to be attached.

As it is not always possible, whatever care may be taken, to exclude all foreign substances from explosive in course of manufacture, I do not consider that blame should be attached to the proprietors of the factory in respect of the scoring, or in respect of the accident, assuming my explanation of the occurrence to be the correct one; but I pointed out to the management when I visited the factory for the purposes of this Inquiry that if the bin in which the explosive was carried from one building to another were conveyed in a closed truck, or covered over, the chance of dust or gritty substances being present in the explosive would be much reduced, and I have no doubt that this suggestion will receive their attention. When I examined the clothing which was worn by Bown at the time of the explosion, I found that he had been wearing under his uninflammable waistcoat (provided by the proprietors) a woollen jacket in which, contrary to the terms of the license there were pockets,* but I see no grounds in the present case for supposing that this infringement of the regulations had any bearing on the cause of the accident.

As to the result of the ignition.

Had the result of the ignition been an explosion instead of a fire, there can be no doubt that Bown would have lost his life. He could not have made good his escape from the building. Explosion may be looked upon as extremely rapid combustion; in the case of gunpowder, if fire is applied to it, the whole in immediate contact burns instantaneously, or "explodes." But this is not necessarily the case with some at least of the nitro-compounds; if the heat of combustion is allowed to escape as rapidly as it is generated, a conflagration, and not an explosion, is the result. The condition for conflagration only and non-explosion with this class of explosives appears to be that no portion shall be raised to the exploding temperature without being set on fire. If the heated gas from some part which is being burnt, or the application of heat without contact of flame (as, for example, when a frozen cartridge of dynamite is being recklessly thawed in an oven or on a shovel over a fire), raises the temperature of any part to the required point the whole explodes.

It is, of course, obvious that this condition cannot be secured in the working buildings of a factory. Although an ignition may happily, in one instance, as the present, lead to a conflagration only, on another occasion an explosion may follow. The danger buildings must, therefore, be placed at such distances apart as to provide against communicated explosion, not fire. If, when an ignition takes place, a fire only is the result, the extra margin of safety is all pure gain.

I have grouped together in Appendix B., as likely to be of interest, the more notable instances of ignition of nitro-compounds, followed by fire and not explosion, included in our Annual Reports since the passing of the Explosives Act.

I have the honour to be,
Sir,
Your obedient servant,
A. FORD, Colonel,
H.M. Inspector of Explosives.

The Right Honourable
The Secretary of State,
Home Department.

* Term 9 of the license is as follows:—"The outer clothing of all work-persons employed in danger "buildings shall be of woollen or other uninflammable material, and no pockets shall be worn by any work-"person employed in any danger building."

APPENDIX A.

Chemical Examination.

No. of sample: 4,476. Date, March 29th, 1895.
Name of material: Cannonite.
From whom received, and when: Colonel Ford. March 15th, 1895.
General result of examination: Stands heat test perfectly, and is correct in composition. The temperature of ignition is 360° F., the same as guncotton, and it is not more sensitive to percussion and friction than the latter.
Details of sample and examination: Sample in brown paper parcel marked "Cannonite thread, from factory at Trimley," "14.3.95, A. F."
Black, brittle, fine threads.
Temperature of ignition, 360° F.
Could not be exploded on stone by a blow from a skin mallet.
Exploded by the fall of a 2-lb. weight, from a height of 12 inches; a like quantity of guncotton exploded by a similar blow.
Heat test gives no action in 30 minutes.
It consisted of:—

Nitro-cellulose and graphite	86·00
Nitrate of potassium	6·88
Rosin	6·19
Moisture	·93
	100·00

(Signed) A. Dupré.

APPENDIX B.

Date.	Index number.	Nature of Explosive.	Place.	Details.	Number of	
					Killed.	Injured.
1882, 15th July.	64–1882	Potentite	Factory No. 35, Lancashire.	Fifteen hundred pounds of potentite in compressed discs in the drying stove ignited and burnt away without explosion. The fire was probably caused by the night-watchman, who improperly took his lantern into the building. (Special Report, No. XLV.)	—	1
1883, 15th February.	38–1883	Tonite	Factory No. 7, Kent.	Cubes of tonite (warm from the drying-room) were being packed in zinc cases, when a cube was ignited by friction. The fire extended to 350 lbs. of tonite in the building, which burnt away without explosion.	—	—
1888, 24th June.	Foreign explosion.	Nitrated guncotton.	Magazine at Düren.	Magazine containing 3,029 lbs. of nitrated guncotton and 2,387 lbs. of wet guncotton was burnt down without explosion. A portion of the wet gun cotton was afterwards recovered intact.	—	—
1889, 4th April.	36–1889	Tonite	Factory No. 7, Kent.	Whilst a tin of tonite was being soldered the contents ignited, and fired some 20 lbs. of tonite in the shed, the whole burning without explosion.	—	—

Date.	Index number.	Nature of Explosive.	Place.	Details.	Number of	
					Killed.	Injured.
1889, 8th October.	91–1889	E.C. powder	Factory No. 122, Kent.	Fire occurred in drying-house, due to ignition of particles of explosive on the floor by the heel of one of the men's boots. The explosive in the building burnt away without explosion except a large tin bottle containing explosive, which caused a slight explosion.	—	1
October.	Government accident.	Guncotton	Fort Matilda	Ninety lbs. guncotton in drying-room ignited by spark from stove burnt away without explosion.	—	—
1890, 6th November.	104–1890	E.C. powder	Factory No. 122, Kent.	About 260 lbs. of E.C. powder was fired by friction (defective machinery) and burnt away without explosion.	—	—
13th May	Foreign accident.	Ballistite	Factory at Avigliana, Italy.	Eight tons of ballistite were burnt without any explosion. The fire was ascribed to the action of a cutting machine, or to overheating of one of the strips of ballistite causing its sudden ignition.	13	—
21st October	Experiments.	Cordite	Government experiments.	Experiments proving that considerable amounts of cordite (600 lbs.), under ordinary conditions of storage, may be burnt without explosion.	—	—
1891, 20th July.	60–1891	Tonite	Factory No. 7, Kent.	A tin case containing 50 lbs. of tonite, when it fired, and burnt away harmlessly.	—	—
1892, 31st January.	Experiments.	Cordite	Government experiments.	Continuation of the 1890 experiments, with much larger amounts. In this case, 2,500 lbs. cordite was fired by a bonfire of shavings, &c. and burnt fiercely, but without explosion.	—	—
1893, 26th May.	42–1893	Smokeless powder.	Factory No. 135, Herts.	A spark from boiler-house chimney entered the window of drying-house and fired the explosive therein, which burnt away without explosion. (Special Report, No. CIV.)	2	—
26th March	Government accident.	Guncotton	Waltham Abbey	Four thousand two hundred and twelve lbs. of guncotton in the stove took fire from some inexplainable cause and burnt away without explosion.	—	—
1894, 19th April.	23–1894	E.C. powder	Factory No. 122, Kent.	A building in which E.C. powder was being dusted was burnt down. 500 lbs. of explosive burnt without explosion. The fire was possibly due to electricity generated in the dry powder.	—	—

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